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ABSTRACT

The 31 papers selected for presentation at the 1981 Association for Educational Communications and Technology (AECT) convention and inclusion in this document were subjected to a rigorous blind reviewing process and represent some of the most current thinking in educational communications and technology. Topics covered include aptitude treatment interaction, television viewing by children, cognitive style, computer anxiety, educational television and films, information processing, instructional design, instructional development, college program evaluation, and learning hierarchies. (Author/LLS)

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PROCEEDINGS OF SELECTED RESEARCH PAPER PRESENTATIONS

at the 1981 Convention of the
Association for Educational Communications and Technology
and sponsored by the
Research and Theory Division
April, 1981 in Phildelphia, PA

Edited by:
Michael R. Simonson
Associate Professor of Secondary Education
and
Elizabeth Hooper
Teaching Assistant

College of Education
Instructional Resources Center
Iowa State University
Quadrangle North
Ames, Iowa 50011

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PREFACE

For the third year the Research and Theory Division of the Association for Educational Communications and Technology (AECT) is publishing these *Proceedings*. Papers published in this volume were presented at the national AECT Convention in Philadelphia, PA. A limited quantity of this volume were printed and sold. It is also available on microfiche through the Educational Resources Information Clearinghouse (ERIC) system.

REFEREEING PROCESS: All Research and Theory Division papers selected for presentation at the AECT Convention and included in this *Proceedings* were subjected to a rigorous blind reviewing process. Proposals were submitted to Dr. Carol Carrier of the University of Minnesota who coordinated the review process. All references to author were removed from proposals before they were submitted to referees for review. Approximately fifty percent of the manuscripts submitted for consideration were selected for presentation at the Convention and for publication in these *Proceedings*. The papers contained in this document represent some of the most current thinking in educational communications and technology.

Michael R. Simonson
Research and Theory Division

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DeKalb, Illinois 60115

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The Interaction of Learner Aptitudes with Instructional Treatment in Quadratic Inequalities

Gary J. Anglin
University of Kentucky

Thomas M. Schwen
Indiana University

John B. Anglin
Eastern Kentucky University

Footnote

This article is based on the senior author's dissertation submitted in partial fulfillment of the requirements for the doctoral degree at Indiana University, School of Education. I would like to thank my dissertation committee: Thomas M. Schwen, Director; Dennis Pett, Chairperson; Billy E. Rhoades; Jerry McIntosh. The author acknowledges support of the Graduate School of Indiana University for a fellowship stipend to help finance the study.

Running Head: The Interaction of Learner Aptitudes

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ABSTRACT

Many questions about the role of individual differences in learning remain to be answered. A review of the literature indicates that the effect of instructional mode may depend on individual learner differences. In the area of mathematics learning the question has been posed: Do spatial and general reasoning abilities interact with instructional treatment. The purpose of this study was to extend a series of earlier aptitude treatment interaction studies. The aptitudes used in the present study included spatial and general reasoning ability. The two treatments dealt with the topic of quadratic inequalities. One treatment labeled graphic was strong in verbal-pictoral-numeric content. The other treatment labeled analytic was strong in verbal-symbolic-numeric content. Interactions between instructional treatment and the aptitudes were observed.

The Interaction of Learner Aptitudes with Instructional Treatment in Quadratic Inequalities

Educators have long dealt with the problem of explaining individual differences in learning. As Glaser (1972) pointed out, the need for individualization of instruction has been recognized since the beginning of the twentieth century. Identification of aptitudes that interact with variations in instruction has been suggested by Cronbach (1957). A review of the literature on aptitude by treatment interactions (ATI) indicates that the effects of instructional treatment may depend on individual learner differences, although significant interactions have frequently been difficult to replicate. Many studies failed to report predicted interactions (Behr & Eastman, 1975; Bracht, 1970; Cronbach, 1975; Cronbach & Snow, 1977; Eastman & Behr, 1977). Consideration of individual differences in the learning process has led to a number of studies investigating possible relationships among student aptitudes and different modes of presenting instruction (Behr & Eastman, 1975; Carrier & Clark, 1978; Carry, 1968; Eastman & Carry, 1975; McLeod & Adams, 1980; McLeod & Briggs, 1980; Webb & Carry, 1975). The principal purpose of the current study was to investigate the interaction of selected aptitudes with presentation mode in mathematics instruction. This study evolved from a series of investigations in mathematics education and the work of the mathematician Poincaré (1907).

In the first of the series, Carry (1968) investigated the possible interaction of spatial and general reasoning abilities with instructional treatment (analytic, graphic) in quadratic inequalities. The investigator hypothesized that spatial ability would predict success from the graphic treatment and that general reasoning ability would predict success from the analytic treatment.

The analytic materials were strong in verbal-symbolic-numeric content, while the graphic treatment materials contained a verbal-pictorial-numeric content. Carry (1968) reported an interaction of the two aptitudes (general reasoning, spatial visualization) with instructional treatment (analytic, graphic). However, the reliability of the criterion instrument was low, and the direction of the interaction was in reverse of that predicted.

A follow-up study by Webb and Carry (1975) used Carry's (1968) suggested improvements. Again, Webb and Carry's (1975) study used two different instructional treatments dealing with the topic of solving quadratic inequalities. Using Melton's (1967) model, Webb and Carry (1975) predicted that spatial ability would predict transfer from the analytic treatment, and that general reasoning would predict transfer from the graphic treatment. Webb and Carry's (1975) prediction of an interaction between aptitudes and instructional treatment was not supported.

In the third of the series, Eastman and Carry (1975) restructured the two treatments used by Webb and Carry (1975). The analytic treatment was revised to make it more deductive, while the graphic treatment was revised to make it more inductively structured. The criterion measure in the Eastman and Carry (1975) study was a relatively difficult transfer learning test. Eastman and Carry (1975) examined the aptitude constructs used by Webb and Carry (1975) in the context of Guilford's (1967) Structure of Intellect model. Using the model, Eastman and Carry (1975) selected the Abstract Reasoning Test of the Differential Aptitude Tests (Bennett, Seashore, and Wesman, 1947) battery as a measure of spatial ability. Selection of the Abstract Reasoning Test as a meausre of spatial ability is questionable. Cronbach and Snow (1977) indicated that this test is usually assumed to be a measure of reasoning ability. Inclusion of additional measures more generally accepted as spatial ability measures would have been appropriate. The Necessary Arithmetic Operations Test from the Kit of Reference Tests for Cognitive Factors (French, Ekstrom, & Price, 1963) was retained as a measure of general reasoning ability in the Eastman and Carry (1975) investigation. Eastman and Carry's (1975) hypotheses were similar to Carry's (1968). An interaction was reported supporting the hypothesis that spatial ability will predict success in the graphic treatment and general reasoning will predict success in the analytic treatment.

Examination of the hypotheses in the Carry (1968), Webb and Carry (1975), and Eastman and Carry (1975) studies points out the need for a model-based approach when generating ATI hopotheses. Salomon (1972) has suggested three models--remedial, compensatory, preferential--for use in ATI hypothesis generation. Carry (1968) hypothesized that spatial ability would predict success in the graphic treatment, while general reasoning would predict success in the analytic treatment (preferential model). Webb and Carry (1975) assumed that spatial visualization would predict success in the analytic treatment and general reasoning would predict success on the transfer test in the graphic treatment (compensatory model). Eastman and Carry's (1975) predictions were similar to Carry's (preferential model).

A comparison of the aptitudes and treatments used in the series of studies with the concepts discussed by the mathematician Poincare (1907) yields further support for the choice of the aptitude constructs of general reasoning and spatial ability and the investigation of their relationship to analytic and graphic instructional treatments. Poincaré (1907) suggested that there are two types of mathematical minds--the intuitive and the logical--that make equal contributions to the advancement of science. Mathematicians taking the logical approach appear to advance using a step by step process, while those using the intuitive approach appear to make quick almost inspirational conquests.

Poincaré (1907) suggested that a genuine difference exists between intuitive and logical approaches and that these differences are not imposed by the particular area of mathematical investigation. A number of examples of mathematicians were provided. One such example is the contrast between Weierstrass and Riemann. It has also been suggested that the same distinction can be made among mathematics students. Some students are not capable of "seeing in space," while others are not as capable of performing long calculations (Poincaré, 1907, p.17).

In the Carry (1968), Webb and Carry (1975), and Eastman and Carry (1975) series, the aptitude constructs selected represent generally accepted traditional constructs. Research which also includes process concepts as individual differences would be useful in an adaptive mode to education (Glaser, 1972). Glaser suggested that the cognitive style concept may be useful in ATI research. One of the most highly investigated cognitive style dimensions is field dependence-independence (Witkin & Goodenough, 1976). In the area of mathematics education, recent studies have reoprted ATI's where cognitive style measures were included (Adams & McLeod, 1979; McLeod & Briggs, 1980; McLeod & Adams, 1980). Cognitive style research, particularly the field dependent dimension, has been criticized by a number of investigators (Cronbach & Snow, 1977; Fine & Danforth, 1975; Reinking, 1977; Satterly, 1976; Vernon, 1972; Wachtel, 1972). The crux of the criticism is that field dependence may be confounded with general intelligence and spatial ability (Vernon, 1972).

The present study investigated interactions between student aptitudes and instructional treatment in quadratic inequalities using the aptitude and treatment variables from the Eastman and Carry (1975) study. In addition: (a) cognitive style and an additional measure of spatial ability were included, (b) instructional treatments, particularly the graphic treatment's illustrations were revised, and (d) subjects were college students. The primary hypothesis focused on interactions. An interaction between student aptitudes and instructional treatment was predicted: students having high general reasoning ability were expected to perform better under the analytic treatment than students having spatial ability, and the graphic treatment was expected to be best for students having high spatial ability (preferential model). Hypotheses including the cognitive style dimension were not generated since inclusion of the dimension was considered exploratory.

Method

Subjects

The 120 students in this study were junior and senior level undergraduate students enrolled in teacher education courses at a southeastern university. The university was in a community of 17,000 people. Students who were familiar with the topic of quadratic inequalities were removed from the sample at the data analysis stage although they were allowed to participate in the earlier stages of the study for administrative reasons. Each student was randomly assigned to one of two programmed instructional treatments.

Instrumentation

The aptitude measures included a spatial ability test, one measure of cognitive style, and two reasoning tests. The test instruments were selected using: (a) the G_f and G_v aptitude complexes discussed by Snow (1980) where G_f refers to "fluid ability" or analytic reasoning, and G_v refers to spatial visualization (after Cattell, 1971), and (b) results from previous studies. The measures of spatial and general reasoning abilities were the Card Rotations Test and the Necessary Arithmetic Operations Test, respectively, selected from the Kit of Reference Tests for Cognitive Factors (French, Ekstrom, & Price, 1963). The Group Embedded Figures Test (Oltman, Raskin, & Witkin, 1971) was selected as the cognitive style measure. In order to replicate the Eastman and Carry (1975) study, the Abstract Reasoning Test, Form T, from the Differential Aptitude Tests (Bennett et al., 1947) battery was also selected.[1]

The criterion measure consisted of a 24-item multiple choice transfer learning test identical to that used by Eastman and Carry (1975). Students were asked to solve problems similar to those presented in the instructional treatment booklets. A limited number of the test items required generalization of the problem solving method presented in the instructional booklet. One point was given for each question. Partial credit was not allowed.

Procedure

The study was conducted midway through the fall semester. On the first day the experimentor explained the study to the students. The participants in the study were informed that they would be taught a topic in mathematics using written instructional materials. Students were informed that they were not required to participate and that their course grade would not be affected if they chose not to participate. Four aptitude measures were then administered to the students. On day two, each student was randomly assigned one of the two instructional treatments (analytic, graphic) in a small group setting. The analytic treatment, based on the properties of signed numbers, was more deductively structured. The graphic treatment was inductively structured, and the method of solution of the quadratic inequalities required that the student learn to draw and interpret the "right" picture. The students had 35 minutes to read and study the assigned treatment booklets. Treatment booklets were collected at the end of the 35 minute period. The following day the treatment booklets were again distributed to the students, each student receiving the same booklet as on day two. They were asked to finish reading the booklet or to reread and review if they had already completed reading the booklet. Fifty minutes were allowed on day three. On the fourth day, the 24-item transfer learning test was administered to all students included in the study. The students were not informed in advance that a transfer learning test would be administered. Data on 20 students were eliminated because the student had either (a) previous knowledge of quadratic inequalities, (b) data missing on the dependent variable, or (c) missed one or more of the instructional periods. Data from 100 students were analyzed.

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[1] As discussed the Abstract Reasoning Test was considered as a spatial ability test by Eastman and Carry (1975).

Results

Descriptive Statistics on Aptitudes and Outcome

Table 1 reports the means, standard deviations, and number of subjects per treatment group for all aptitudes and for the outcome measure. Table 2 shows the intercorrelations of aptitudes and outcomes by treatment and the reliabilities. The pearson product-moment correlation between parts one and two were used as rough estimates of internal consistency for the Card Rotations Test and the Group Embedded Figures Test. It was interesting to note that the mean of the transfer test score was slightly higher in the analytic group. A similar but non-significant difference was also reported by Eastman and Carry (1975).

Insert Table 1 about here

Intercorrelations of Aptitudes and Outcome

A substantial difference in the correlation coefficients between the Necessary Arithmetic Operations Test and the transfer test across the graphic and analytic treatment groups ($r = .59$ in the analytic group, and $r = .28$ in the graphic group) was observed. (See Table 2.) This result suggested the possibility that an ATI may exist since the relationship between the general reasoning measure and the outcome measure was not the same across treatments. A similar but less pronounced difference appeared between the Abstract Reasoning Test and transfer test ($r = .39$ for the analytic group, and $r = .47$ for the graphic group). The difference across treatments in the correlation between the Card Rotations Test and the transfer test score as well as in the Group Embedded Figures Test and the transfer test score appeared modest. Most aptitudes are intercorrelated with one another--a fact to be considered when entering terms into regression.

Insert Table 2 about here

The relatively low correlation between the Card Rotations Test and the transfer test should be noted. Any of the results including the Card Rotations Test should be interpreted with caution. An unexpected pattern was found for the Necessary Arithmetic Operations Test and the Group Embedded Figures Test across treatments. The correlation between the Necessary Arithmetic Operations Test and the Group Embedded Figures Test was .45 in the analytic treatment group and .29 in the graphic treatment group.

Aptitude X Treatment Interactions

The outcome measure (transfer test) was regressed on all aptitudes in the full model using a stepwise procedure suggested by Cronbach and Snow (1977). Treatment groups were coded using a dummy coding procedure (Kerlinger & Pedhazur, 1973). A predetermined order was used to enter all aptitude terms into regression. Aptitude terms were entered, then the treatment term, first-order ATI, and finally second-order ATI were entered. Deviation scores for the aptitude measures were used as recommended by Cronbach and Snow (1977). Stepwise regression analysis was performed using the multiple regression subprogram from the Statistical Package for the Social Sciences (Nie et al., 1975). Table 3 presents the results of the stepwise regression analysis of the criterion test on the aptitude meausres. The significance of main effects and ATI was tested using a procedure discussed by Kerlinger and Pedhazur (1973).

Insert Table 3 about here

As shown in Table 3, the full regression equation accounted for 57.5% of the variance in transfer learning. Two main effects AR and NAOT were significant and accounted for 17.0% and 8.9% of the variance in transfer learning, respectively. The other aptitude and treatment terms did not contribute significantly to the prediction equation, Significant ATI's were observed. One first order ATI was detected--NAOTxTrt accounting for 3.5% of the variance in the full model. This was consistent with the correlational pattern found between NAOT and the transfer test (see Table 3). The ARxNAOTxTrt term accounted for 3.3% of the variance and was statistically significant, replicating the results of Eastman and Carry (1975).[2] An additional interaction, ARxCRxTrt, also was observed, accounting for 3.3% of the variance. It must be noted that this interaction should be interpreted with caution since the correlation between the Card Rotations Test and the transfer test was low. All terms including the Group Embedded Figures Test accounted for a total of 2.5% of the variance in the full model. Table 4 reports the regression equations for the analytic and graphic treatment groups.

Insert Table 4 about here

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[2] If one assumed as Eastman and Carry (1975) that AR is a measure of spatial ability.

Discussion

The results of the present study replicate and extend the findings of Eastman and Carry (1975) and other studies which have indicated that learner aptitudes interact with instructional treatment in mathematics. The two second order interactions--Abstract Reasoning x Necessary Arithmetic Operations x Treatment (ARxNAOTxTrt) and Abstract Reasoning x Card Rotations x Treatment (ARxCRxTrt)--observed in this study warrant further discussion. As indicated, Cronbach and Snow (1977) questioned Eastman and Carry's choice of the Abstract Reasoning Test as a measure of spatial ability (G_v). In the current study the Card Rotations Test was added as an additional spatial ability measure. The ARxNAOTxTrt interaction included the Abstract Reasoning Test as the spatial measure and the Necessary Arithmetic Operations Test as the general reasoning measure. On the other hand, the ARxCRxTrt interaction included the Abstract Reasoning Test--considered by Eastman and Carry as a spatial measure--and the Card Rotations Test. It could be inferred that the ARxNAOTxTrt term was an interaction between spatial and general reasoning abilities with instructional treatment and that the ARxCRxTrt was an interaction between two spatial abilities (Abstract Reasoning Test, Card Rotations Test) and instructional treatment. However, these inferences are not supported in light of the assumptions usually made about the Abstract Reasoning Test. Cronbach and Snow (1977) suggested that the test is usually regarded as a reasoning test, and that Eastman and Carry's use of the Abstract Reasoning Test as a spatial test was not justified.

If it is assumed that the Abstract Reasoning Test is a nonverbal reasoning test, different conclusions follow regarding the two second order interactions observed in this study (ARxNAOTxTrt, ARxCRxTrt). Making this assumption, a more tenable interpretation of the results is that the ARxNAOTxTrt interaction was an interaction between two reasoning measures of the G_f aptitude cluster. In this case the ARxCRxTrt interaction would be the only significant ATI term containing a spatial measure--with the Card Rotations Test being the spatial measure and the Abstract Reasoning test a non-verbal reasoning test.

The previous discussion suggests that the two significant second-order interactions draw on different aptitude constructs. In the case of ARxNAOTxTrt, the interaction may be between two general reasoning constructs subsumed under G_f, with the ARxCRxTrt interaction being between one general reasoning (G_f) and one spatial (G_v) factor.

Use of the Group Embedded Figures Test to measure the cognitive style dimension did not contribute significantly to the model used in this study. Only 2.5% of the variance was accounted for by all terms that included the style measure. An examination of the intercorrelations of the Group Embedded Figures Test with other ability measures used in the study supports the claims made by critics of the style dimension--field dependence-independence may be confounded with other ability measures.

More research is needed to explain ATI's in mathematics learning. The relationship between the spatial skills assessed by the aptitude measures and those required by the treatment need to be further investigated (Cronbach & Snow, 1977). The low correlation between the Card Rotations Test and the criterion measure may be due to the fact that the task requires different spatial skills than does the spatial treatment. Task analysis methods could be used to help identify skills required for the spatially-oriented treatment on quadratic inequalities. This information would be useful when selecting individual difference measures which require skill similar to that used in the spatial treatment.

Additional correlational analysis examining the relationship between various marker tests in the G_v cluster and task success in the graphic and analytic treatments would be desirable. It would then be easier to select spatial measures which predict success differentially across treatments. Use of the spatial and general reasoning treatment dimensions when investigating ATI's in mathematics learning is worth further investigation.

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Table 1

Descriptive Statistics for Aptitudes and Transfer Test by Instructional Treatment

Instrument	Treatment	Mean	Standard Deviation	Range	n_i
Abstract Reasoning	Analytic	39.17	8.20	20-50	47
	Graphic	39.49	5.57	26-48	53
Necessary Arithmetic Operations Test	Analytic	15.66	4.70	5-23	47
	Graphic	14.74	4.87	4-25	53
Card Rotations	Analytic	120.21	47.28	35-222	47
	Graphic	114.96	31.91	55-194	53
Group Embedded Figures Test	Analytic	8.92	5.37	0-18	47
	Graphic	9.79	4.66	0-17	53
Transfer Test	Analytic	10.43	5.01	1-21	47
	Graphic	9.02	4.27	2-19	53

Table 2

Intercorrelations of Aptitudes and Outcome by Treatment (Reliabilities on the Diagonal)

Variable	Treatment	1	2	3	4	5
1. Abstract Reasoning (AR)	Analytic	.87[1]	.56	.55	.60	.39
	Graphic		.24	.35	.49	.47
2. Necessary Arithmetic Operations Test (NAOT)	Analytic		.80[1]	.38	.45	.59
	Graphic			.13	.29	.28
3. Card Rotations Test (CR)	Analytic			.75[2]	.51	.16
	Graphic				.21	.21
4. Group Embedded Figures Test (GEFT)	Analytic				.80[2]	.40
	Graphic					.39
5. Transfer Test						.78[3]

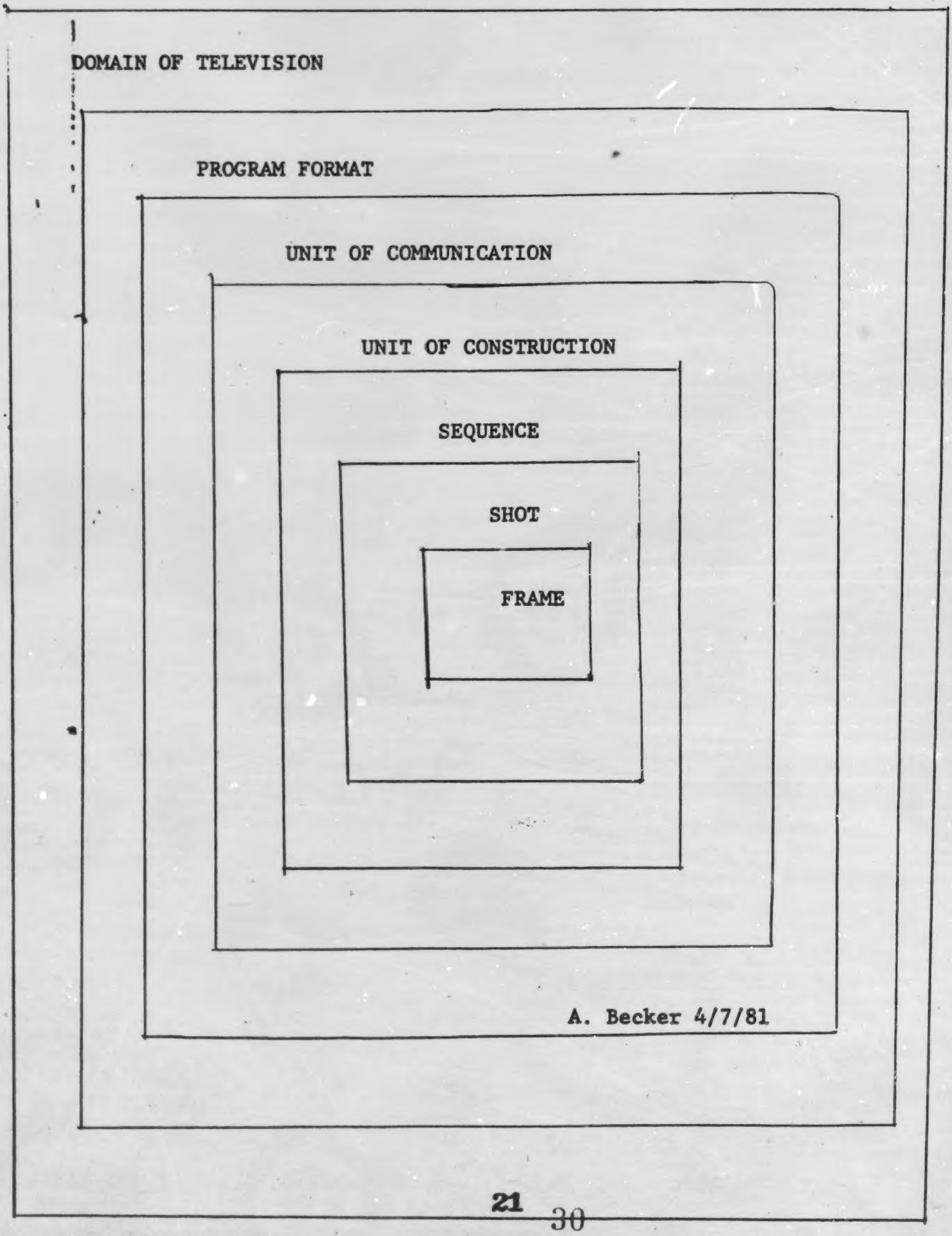
[1] Kuder-Richardson
[2] Pearson product-moment correlation between parts 1 and 2
[3] Cronbach's Alpha

Table 3

Summary of Variance in Performance Accounted for by Main Effects and ATI

Variable in Regression	df	% of variance accounted for	F
Full Model	15	42.5	--
Aptitudes			
Abstract Reasoning (AR)	1	17.0	24.83 **
Necessary Arithmetic Operations Test (NAOT)	1	8.9	13.00 **
Group Embedded Figures Test (GEFT)	1	1.6	2.34
Card Rotations (CR)	1	0.3	.44
Treatments	1	2.2	3.21
Aptitude Treatment Interactions			
ARxTrt	1	0.9	1.31
CRxTrt	1	0.6	0.88
GEFTxTrt	1	0.2	0.29
NAOTxTrt	1	3.5	5.11 *
ARxNAOTxTrt	1	3.3	4.82 *
GEFTxNAOTxTrt	1	0.6	0.88
CRxGEFTxTrt	1	0.1	0.15
ARxGEFTxTrt	1	0.0	0.00
ARxCRxTrt	1	3.3	4.82 *
CRxNAOTxTrt	1	0.0	0.00
Constant = 9.92	--	--	--
Residual	84	57.5	--

* $p < .05$
** $p < .01$


DOMAIN OF TELEVISION
PROGRAM FORMAT
UNIT OF COMMUNICATION
UNIT OF CONSTRUCTION
SEQUENCE
SHOT
FRAME

A. Becker 4/7/81

Table 4

Regression Equations for Transfer Learning Showing Partial

Regression Coefficients for Each Treatment

Treatment (Trt)	Constant	b for AR	b for CR	b for GEFT	b for NAOT	b for ARxNAOTxTrt	b for GEFTxNAOTxTrt	b for CRxGEFTxTrt	b for ARxGEFTxTrt	b for ARxCRxTrt	b for CRxNAOTxTrt
Analytic	-1.67	.06	-.02	.06	1.05	-.01	-.02	.00	.01	.00	.00
Graphic	-2.17	.26	.00	.24	-.35	.01	.02	.00	-.01	.00	.00

Note AR = atstract Reasoning Test; CR = Card Rotations Test; GEFT = Group Embedded Figures Test; NAOT = Necessary Arithmetic Operations Test

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TOWARD A GRAMMAR OF EDUCATIONAL TELEVISION:

Part II, Method

Ann De Vaney Becker
Associate Professor, Educational Technology
University of Wisconsin-Madison

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Toward a Grammar of Educational Television: Part II, Methodology

Arguments for and a delineation of a theoretical model for the analysis of educational television codes have been made in an earlier paper (Becker, 1979). Briefly, the author borrowing concepts from semiotics, suggests a grammatical analysis of educational television. Such an analysis would describe syntax or the linear aspects of construction, such as frame and shot in the formation of an educational television sequence. Since syntax exists only within and because of a communication, analysis would be conducted within units of communication. Such units of communication have been coded in other media and often bring their codes or infrastructure to the medium of television. The appearance of new syntax or new use of the units of construction would indicate a grammar unique to television.

This paper will attempt only to summarize the rationale for the formulation of such an analysis. It is not the purpose here to mount arguments in support of that analysis, but to offer a background to the current discussion. It is the purpose of this paper to present an analytical model for the grammatical description of educational television.

Background

Historically, educational technology research on television moved from a gross comparison of television with live lecture (Sykes, 1964; Williams, Paul and Ogilive, 1957; Pflieger and Kelly, 1961 and Schramm, 1962) through an increasingly sophisticated series of studies (i.e., Chu and Schramm, 1967, Koran, Snow and MacDonald, 1971, Salomon, 1979) to a consideration of the unique characteristics of television. Some researchers, such as Salomon (1979) have attempted to identify these characteristics as codes. Although current questions about the unique characteristics of television abound, there is little knowledge about TV codes and symbols.

Codes and symbols have been described, however, in other media such as cinema, and literature, by the system of semiotics. Christian Metz (1974), for example, has initiated a detailed account of the codes and symbols of narrative cinema.

Purpose

What I believe is necessary, here, is the establishment of an analytical model for the description of television grammar. Successful attempts to "read" film in this manner have been made by Christian Metz (1974 a, 1974 b) and other semiotic analysts (Wollen, 1969, Monaco, 1977 and Bettetini, 1973), and although Metz has developed a sophisticated analytical model for "reading" film, it is one based on individual interpretation. The challenge in borrowing some of Metz's rich concepts of interpretation would be to introduce the elements of verification and generalization demanded by research in the social sciences. Metz, however, begins his analysis with a helpful code set theory. For purposes of this paper, I will refer to code as the tacit rules or regulations which develop in the practice of constructing the units of frame, shot and sequence within television or film. Metz's contention, then, is that one must distinguish the source of codes involved in the construction of a sequence, consequently he has developed a code set theory. His theory attempts to trace those codes which are derivative, not unique to cinema, and to describe those unique to the medium. He does this to provide a fuller understanding of the contribution of one medium to another and to highlight the new use of an old code. Metz would agree with most[1] film theorists that "montage" is the only unique cinema code . Identification of codes unique to cinema initiated a grammatical description of film.

It is necessary to trace the origin of a code in order to understand its use in the new medium. Metz offers a code set theory which includes the listing of the domains of general culture, cinema and theater among others. Within those domains he lists shared and non shared codes. Codes of lighting and narration, for example, would be shared by general culture, cinema and theater. Montage would be non shared, specific to cinema.

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[1] Kjorup (1977), however, states that there are no codes unique to film. He believes that "montage" can be found in novels.

This analysis attempts to trace the origin of the code, that is, the tacit rule which developed for the presentation of a given communication, by naming the "domain" from which it came. "Domain" for Metz has vast implications and can mean another genre as well as something he calls general culture. Although his concept is vast and he has not been totally successful in articulating the origins of many cinematic codes, his theory again is rich and well suited to a semiotic analysis of television.

If one was to consider the proximate sources of one form of television at a time, such as dramatic narrative, and to define these origins with some specificity, i.e., the domain of general culture would include subdivisions addressing those social and economic forces as well as aesthetic forces which shape the construction of a unit of communication for television, then the code set theory would offer a superstructure for television analysis. Such a structure, when applied to television, would supply a frame within which to chart the pattern of old codes or the appearance of new ones. This charting need not be accomplished by individual "reading" of the television message, but can be recorded and analyzed by micro computer.

The television analysts who knew the origin of the codes would be able to make informal comparisons between the use of the code in the old and new medium. An understanding of the structure of television might grow in that fashion.

Codes and Formats

What the identification of a superstructure or overarching model will allow this analysis to describe is the syntax within a television format.

Film syntax has undergone partial analysis in such a manner, although not in a rigorous fashion. Monaco, for example, has described the syntax of dialogue as it existed in Hollywood films of the 50's (such syntax is currently being copied by most dramatic television sequences today.) Serious film analysts when employing the method of individual interpretation, work within one format at a time. Indeed, they work to describe one communication at a time, within that format. This work suggests that elements within a given communication from one format arrange themselves in a pattern. Such a pattern may be labeled the syntax of the given communication. Analysis, then, takes place initially at the micro rather than macro level. If one postulates, then, that unique patterns exist within television, it would seem appropriate to study these patterns similarly within the genres[2] or formats of television. These formats are variously described in the television literature. A survey of this literature and an appraisal of TV programming[3] recommended the following categories for consideration as format: dramatic narrative, situation comedy, documentary, news, advertisements, variety shows, talk shows, soap operas, game shows, musical presentations, sports presentations and dance. In no way is this classification proposed as all inclusive, nor are the categories always discrete. It is a classification which allows this structural analysis to begin.

The codes, for example, of a TV format, such as dramatic narrative[4] supply the infrastructure in which to examine syntax. The assumption, here, is that syntax is developed differentially within varying forms of communication. For example, words can only be linked for the purpose of communication otherwise one has nonsense phrases. So then, can video syntax only be studied and situated within a communication in a given format. The temptation, of course, will be to isolate and control units of syntax, especially if one is used to conducting behavioral research. So, there is a necessity to emphasize the fact that syntax, not only exists to facilitate a communication, but can only be studied within the format of that communication.

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[2] Genre is a rather formal word which, in practice, carries with it the baggage of aesthetics. It is the belief of this researcher that television cannot yet be called an art form and because of commercial constraints may never reach an artistic stage, so that the description of programs or formats becomes pretentious when called a "genre".

[3] It is not the intent of this analysis to address the possibilities of TV programming, but to consider television "in practice," as it is viewed today.

[4] Television, like film, is an essentially narrative form. At first glance, the form of television might appear to be dramatic, since there are usually actors talking with one another, on screen. The essence of narration, however, is the telling of a story by a story teller. Dramatic television tells a story through the eyes of a storyteller, the camera. It has "point of view".

The question, of course, could eventually be posed about the similarity of syntax between or among formats. For example, units of frame construction might be similar across formats. There is a danger, however, in pursuing that question in the early stages of the research.[5] Since one is analyzing units of communication, it must be remembered that these units take their meaning from format codes. A series of fast cuts from close up framed face to close ups of another framed face have no meaning of their own. They may exist only in relation to the communication within the format in which they are found. For example, they may exist to advance the plot by displaying tension between the central characters whose faces are framed, if, these cuts exist within a dramatic narrative.

The metaphor of language for film or video construction is weak at the smallest unit. A picture is not like a word; it contains numerous "bits" of information, while a word usually contains one or two bits of denotive information. A picture is highly denotive, while a word can be moderately denotive, but highly connotive. The strength of the metaphor exists, however, because the concept of grammar can be understood by the layperson and the researcher alike. Basic language structure has been a part of standardized public education for years, so the unit of the sentence or the paragraph is generally understood. The communicative links, then, between words, phrases, sentences and paragraphs are generally understood and used daily in common speech and writing. The metaphor gains strength, then, from a comparison of this linkage, this syntax.

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[5] A consideration of patterns within TV formats would not exclude a later analysis of patterns between formats. Such between format analysis might contribute a micro description to those TV analysts following Raymond Williams (1974) "flow concept" of television programming. If what Williams indicates were true, that is, if an evening's programming constitutes a unit of communication itself, then comparisons of patterns between formats presented in one evening's programming could help support his concept and better describe the "flow".

Units of Construction

In conducting an analysis of the manner in which form structures content, one speaks of the smallest units of meaning (Metz, 1974, Monaco, 1977, Bellman and Jules-Roselte, 1977). A researcher is, then, faced with the problem of selecting the most salient units of form or construction for appropriate interpretation. Since there are thousands of units of form within a visual frame, the task becomes difficult. It is necessary to select those dominant units which most apparently contribute to the meaning. Several approaches can be taken, since the question is a variant on "how does a viewer read a frame, a shot, a sequence?" No truly verifiable answer to this question exists. Art theorists write about reading line, shape, and color (Bloomer, 1976). Perception theorists (Kennedy, 1974, Gibson, 1969) write about frame, surface, edge, focal point, proximity and angle of approach. Gestalt theorists such as Kohler and Yerkes, place emphasis on figure, ground, proximity and closure when identifying important units of form.

Film makers and critics identify salient units of form such as frame and shot in motion visuals. Millerson's (1966) popular basic text in television production lists frame, shot, and sequence as important units of television.

Selection and Validation. - This researcher, after reviewing the literature on units of form, compiled an extensive list of these units. The list was informally presented to educational video directors and camera people. Their task was to prioritize these units, so that a sense of which units were most important in practice would emerge. Their knowledge about usage existed at such an intuitive level that it was hard to elicit a response to that list. When interviewed, however, and asked "What do you shoot? How do you construct your shot, your scene?" they replied in the language of the units of form. (This is verification of the fact that a TV grammar probably exists at an intuitive level and remains, as yet, undescribed.) In a circuitous way, they returned to the original list. Mentioned most frequently were frame, shot and scene or sequence. Within a frame the distance, angle, lighting and center or focal point received most mention. Motion within shots was spoken of in conventional terms of zooming, panning, tilting, and dollying or trucking. And motion between shots was mentioned in conventional terms of cutting, fading, wiping and dissolving. If this research were not conducted with social science methods, the author could have selected conventional units of form from the research. The validation process used here appears circuitous, since it returns to conventional units. The step was, however, necessary. The list which will constitute the base of a computer program for micro analysis of television has face and content validity.

Levels of Syntax

Frame, shot and sequence may be described as levels of video construction. To discover the existing relationship among these levels, it is necessary to name the smaller units of construction within these. First, however, a definition of the levels should be included.

A frame is the image which the cameraperson selects and borders within the boundaries of his/her lense. (production 525 lines traced in 1/30 sec =

1 frame repeat rate of 30 stills/second, 262.5 alterate traced 1/60 sec = field freq. of 60/sec reduce flicker). Each line scanned in 635 microsec. or at rate of 15,750 lines/second). (Millerson, 1966)

Shot - within camera movement (subjective motion) or within set movement (objective motion) from frame to frame constitutes a shot.

Sequences are self contained series of shots achieved technically by within or between camera switches.

Subcategories can be listed and programmed as follows:

1. Opening and Closing Frame
    a) Border (Open, Closed)
    b) Focal Point
    c) Focal People #
    d) Lighting (Back)
    e) Focal Distance (Long, Medium Long, Medium, Medium Close, Close)
    f) Focal Angle (Top, High, Level, Low, Low Level)
2. Shot
    a) Opening Frame
    b) Switch
        1. Between--Fade, Cut, Dissolve, Superimposition, Wipe
        2. Within--Zoom, Pan, Dolly, Truck, Tilt
    c) Closing Frame
3. Sequence
    a) Opening Shot
    b) Closing Shot

One cannot haphazardly examine these levels of syntax, but as described above, one can examine them within one given communication of one format at a time. One might examine the syntax of openings or settings or human interaction in documentaries.

One might examine the syntax of advertisements which use testimonials. This researcher is examining what television does to a traditional plot in dramatic narrative. This study will be briefly described to illustrate the analytical model in action.

Procedures

Segments from dramatic narrative prepared and presented on educational channels have been videotaped. These segments include examples of narrative units falling along the plot line of traditional drama. They are, 1. openings 2. suspense 3. climax 4. denouement.

A program of observation and recording of elements for video programs has been developed and modeled after the observation program (SSR) developed by Gordon Stephenson at the Primate Center, University of Wisconsin-Madison. The SSR methods of coding and transcribing behavior are well suited for adaptation to an observation of the television screen.

An Apple II Computer interfaced with a Betamax recorder/player is programmed to record the time of appearance, frequency and duration of units of television construction in the segments of frame, shot and sequence. The subcategories of these segments, listed above, are recorded and the program answers questions about them.

Data Analysis

The Apple II Computer, not only records the frequency and duration of the units of construction under study, but supplies a printout for appraisal of these data. These data are submitted to a time series analysis. Patterns of use, it is hoped, will emerge in this fashion. These patterns constitute the codes this study is seeking. These codes will then be included in a descriptive report and summarized, where needed, in graph form (i.e. frequency plots). It is hypothesized that patterns of usage, namely codes, will emerge when these data are examined. It is further hypothesized that some of these codes will be unique to television.

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INSTRUCTIONAL DESIGN
AND
DIRECTED COGNITIVE PROCESSING

Ruth Colvin Bovy

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Instructional design research has been slow to reformulate research questions that would provide psychologically valid prescriptive instructional principles. The fruitlessness of two decades of media comparison studies has been comprehensively reviewed and discussed (Salomon & Clark, 1977; Salomon, 1978). The "no significant difference" outcomes of the Media A vs. Media B comparison studies era has led to generalizations that hardware, as typically used, serve primarily as effective delivery devices and that most instructional objectives can be achieved via any delivery system (Jamison, Suppes & Wells, 1974; Schramm, 1977).

Following the media comparison era, a more recent emphasis on the effects of various instructional strategies such as advance organizers, preinstructional strategies and orienting tasks has attempted to identify relevant instructional attributes--that is to define elements of lesson design that would yield reliable generalizable effects. The results from such research efforts have not been much more illuminating than the earlier media comparison studies. Clear cut replicable instructional guidelines have been the exception rather than the rule.

One reason for this disappointing lack of progress may lie in the failure to analyze the impact of educational treatments on internal psychological processing operations of individual learners. An instructional treatment which is unattended by learners cannot be expected to have any impact on learning. In spite of the apparent obviousness of this observation, many studies attempting to assess the effectiveness of a particular strategy with a group of learners do not verify that the treatment was in fact attended. Even if it could be assumed that all learners equally attended a specific instructional variable, the way in which it interacts with each individual's cognitive processes is likely to be ideosyncratic. Therefore rather than study a defined instructional treatment, the independent variable may exert diverse effects with different learners and thus be lacking in construct validity. Conversely, diverse instructional approaches may lead to equivalent effects on learning outcomes to the degree that similar cognitive processes are activated by instructional methods whose surface characteristics seem very different (Olson, 1972). As Gagne (1980) stated: "In developing programs of instruction, one must solve the problem of lesson design and media selection by reference to mental states and mental processes, rather than simply in terms of behavioral outcomes" (p. 7). It is the purpose of this paper to define likely points of interface between instructional treatments and cognitive processes and to suggest a unifying relationship between instructional strategies and cognitive processing operations which could serve as a basis for focused research and instructional development efforts.

Instructional Design and Theories of Instruction

Initiated by Bruner's (1964) distinction between the descriptive nature of learning theory versus prescriptive principles of instructional theory, a separate science of instructional design has gradually emerged (Glaser, 1976). Reigeluth, Bunderson, &

Merrill (1977), have suggested three levels of instructional design professional including the instructional design scientist whose research provides principles of design which serve as blue prints to be applied by an instructional technologist to the development of specific instructional materials which are produced by an instructional technician. A more cost effective and instructionally sound product should result from the division of labor and from decreased need to empirically validate instruction which is based on previously established principles. They concluded, however, that such an approach is not currently feasible as "the young design science of instruction has not yet developed the necessary procedures for instructional design nor even derived the prescriptive principles from which these procedures can be developed" (p. 13).

One reason for the general lack of valid and useful principles to apply to instructional design problems has been the failure to generate comprehensive theories of instruction to serve as paradigmatic frameworks for designing research studies and interpreting results. Such instructional theories would provide coherent sets of principles and constructs which would link instructional strategies to learning outcomes and provide a unifying focus for the future formulation of research hypotheses. There have been recent claims that such theories are unlikely to ever be identified either because the learning process is inherently stochastic, there being no generalizable behavioral regularities (Scriben, 1980), or because learning is a function of higher order interactions exerting a "hall of mirrors" effect which severely limits the generalizability of principles (Cronbach, 1975). Others are more optimistic, claiming that even if enduring principles cannot be identified, we can develop "skeleton hypotheses" (Salomon, 1979) or "local theories" (Snow, 1977) which can serve as guiding principles for the science of instructional design.

Most instructional development research to date can be classified as being based heavily on either logical or psychological premises. Variations of the instructional systems approach emphasize an orderly analysis of learner goals and desired outcomes as a basis for development of internally consistent objectives, task hierarchies, and instructional sequences which utilize a logical development framework. In contrast, psychological approaches attempt to formulate instructional methods based on learning theory and include such diverse approaches as programmed instruction based on behavioral stimulus-response psychology, modeling based on social learning theory, or advanced organizers based on cognitive theory. Instructional development can no doubt benefit from an optimal synthesis of both the logical and psychological approaches. It is the psychological approach to instructional development however which offers the most promise as a foundation on which to build a theory of instruction.

Only by delineating the specific mechanisms whereby particular classes of instructional approaches can elicit desired learning outcomes can we generate optimal prescriptive instructional design principles. An analogy can be drawn to the judicious application of drugs to combat various illnesses. A trial and error approach may identify drugs which have some positive therapeutic effects. However only by knowing the metabolic basis of drug action can its usefulness be most reliably applied to optimize its effect. By knowing how the drug mediates its therapeutic effects, its dosage, appropriate application to various pathologies, and possible interactions with other medications can be determined and extrapolated to a variety of situations on an a priori basis.

Coincident with the emergence of the science of instruction as a distinct entity from the science of learning in the 1960's, a major paradigmatic shift occurred in psychology from behavioristic to cognitive perspectives which provides an excellent potential vehicle whereby mechanisms of instructional approaches can be defined (Wittrock, 1979). The cognitive approach emphasizes the psychological processes intervening between stimulus display and the change in behavior called learning. A great deal of work of particular relevance to instruction focuses on the internal mental stages which mediate cognitive assimilation of stimuli and is referred to in general as the information processing model. The bulk of "no significant different" results in research attempts to identify the "best" instructional methodology may reflect in part insensitivity to ways in which a particular information display is processed by different learners. It may be that the initial internal representation of any given display will vary substantially from learner to learner as a function of psychocognitive variables which make the processing effects of any given strategy unique to specific classes of learners. By remaining unaware of these mental interfaces attempts to identify learning effects on the basis of surface characteristics of educational treatments are likely to fail.

The information processing model then provides a promising basis on which to derive linkages between instructional methodologies and learning outcomes--in other words on which to build a comprehensive theory of instruction. The remainder of this paper will outline characteristics of the major information processing constructs including attention, encoding and rehearsal, working memory, long term memory, retrieval, and metacognitive processes and propose a unifying relationship between instructional design strategies and cognitive operations. Specifically, the locus of cognitive processing--whether heavily assumed by the instruction, activated in the learner via the instruction, or maintained in control of the learner will be explored in relation to each major cognitive processing operation. Evidence will be discussed which suggests an inverse relationship between the extent to which the instruction assumes or directs cognitive processing operations and the aptitudinal strengths of learners. The implications for the instructional design and research professional for optimal assignment of cognitive processing--whether to the instruction or to the learner will be presented.

Information Processing and Instructional Design

The information processing model incorporates stages of stimuli processing which generally include initial sensory reception, a transient iconic or echoic storage, and encoding and storage in a limited capacity working memory as well as in a large capacity, more permanent, long term store. Processes in the model which facilitate the internal flow of information and which are of particular interest to instructional design include attention, rehearsal and encoding strategies, retrieval of information from long term memory, and higher level control operations including metacognitive (Flavell, J. H., 1979) or self referent evaluation of learning. Along with a brief description of the characteristics and potential instructional relevance of these major cognitive processes, a proposed framework integrating instructional treatments with cognitive processing operations will suggest the locus of cognitive processing as a tentative general instructional principle.

Any particular instructional strategy such as the use of color, inclusion of pictures, insertion of questions will only be effective to the extent to which it facilitates cognitive processing in some way that the learner would not have done otherwise. This interfacing between external stimuli and internal processing can be accomplished by one of the following three general approaches: supplantation, instructional directed/learner generated, and learner control.

At one extreme most or all of the cognitive processing can be performed or modeled by the instruction. Salomon (1979) referred to this strategy as "supplantation" where the cognitive processing events are simulated by the instruction itself. In his classic filmic modeling experiment, Salomon (1974), 1979) demonstrated that cue attendance behavior of learners initially scoring low in cue attendance was enhanced by a filmic treatment which consisted of repeated zooming in and out of details in a picture. The zooming of the lens onto successive details was proposed to duplicate or provide a close analogy to the necessary cognitive operations relevant to cue attendance.

A second, more intermediate strategy, which can be termed Instructional System Directed/Learner Generated processing includes instances where the cognitive processing is activated by an instructional event but the actual processing is learner generated. Rigney (1978) referred to this approach as an "Instruction System Assigned" Learning Strategy in which a variety of orienting tasks applied to specific content bridges would direct cognitive processing in an optimal manner. Such directed cognitive processing may be operationalized not only by use of various orienting tasks such as adjunct questions, but in a more subtle way by manipulation of features of the instructional display itself. Several studies support the retention facilitating effects of learner generated words (Slamecka & Graf, 1978), text meanings (Doctorow, Wittrock & Mark, 1978), and problem solutions (Jacoby, 1978). In instructional directed strategies such generation would be undertaken by the learner in response to deliberate instructional strategies.

Finally at the other end of the continuum, cognitive processing can be a function of total learner control. Under such circumstances, the instruction provides minimal cognitive processing support. This approach will be successful to the extent that the learner has developed adequate internal ideosyncratic processing strategies which can be effectively applied to the instructional material. Learners of high aptitude would typically fall into this category and, in fact, in instances of supplantation or instructional-directed processing, they frequently exhibit decrement in performance. Salomon (1979) states "as the modeled operation supplants its mental counterpart it interfers with the smooth mental application of the individual skill by already skillful subjects" (p. 155). Likewise Cronbach & Snow (1977) generalize "When one treatment is fully elaborated, whereas the other leaves much of the burden of organization and interpretation to the learner, the regression slope in the former tends to be less steep. That is, highs profit from the opportunity to process the information in their own way; lows tend to be handicapped. This is not a universal rule, but it encompasses a wide range of results" (p. 500). It may be that high general aptitude is, by definition, the ability to efficiently process information by well developed ideosyncratic strategies.

It is proposed then that any cognitive processing operation such as attention, encoding, or rehearsal for example, can be primarily assumed by the instruction (supplantation), directed by the instruction but generated by the learner (instructional directed), or totally assumed by the learner (learner control). Further it is suggested that which strategy a designer chooses would be a function of learner aptitude and prior knowledge with higher ability or more knowledgeable learners benefiting generally more from the learner control range of the continuum and learners of lower aptitudinal strength benefiting from greater instructional assumption or activation of necessary cognitive operations which they could not spontaneously undertake on their own. Specific instances of the instructional assigned strategies i.e. supplantation and instructional directed, will be presented as they relate to each cognitive processing operation to be followed by a discussion of learner control as it relates to various learning strategy programs and recent adaptive computer assisted instruction research.

Attention: Filters & Schema

The phenomenon of attention exerts a highly pervasive impact on the learning process and is of critical importance to instructional design. Therefore theories of attention from the information processing perspective have direct relevance to both research on and application of various instructional approaches. The vast amount of sensory data in the environment available to the organism coupled with the relatively narrow range of stimuli which are selected for processing at any given point has led to postulation of a limited capacity selective attention capability. Early theories (Broadbent, 1958; Triesman, 1964) postulated one or more filters whereby irrelevant features of the data entering the sensory receptors were screened out and only those inputs selected for attention were permitted to enter higher levels of processing. The filter mechanism was based in part on shadowing experiments where two independent messages were spoken simultaneously into the subject's right and left ear. To selectively direct attention, the subject was instructed to shadow by repeating aloud one of the messages. When asked about the unattended message, the subject could not identify elements of the message beyond some general physical dimensions i.e. whether the voice was that of a male or female. Thus although exposed to auditory stimuli from both ears, beyond a very general physical quality detector, information from the unattended ear was filtered out.

Neisser (1976) has rejected the filter model of selective attention and proposed a more parsimonious positive selection mechanism. He suggested that rather than discard or filter out unwanted stimuli, the subject instead actively selects relevant features from the environment. He bases his argument in part on the effects of superimposed video images which subjects had no trouble selectively attending. He argues that since superimposed visual images are highly artificial stimuli, subjects would not have any natural filtering mechanism whereby to screen out the unattended message. Since subjects had no problem performing such a screening function, presumably in the absence of filters, a positive selective strategy is more plausible. Neisser (1976) proposes an interactive dynamic mechanism as the basis for selective attention in which cognitive structures are:

> anticipatory schemata that prepare the perceiver to accept certain kinds of information rather than others and thus control the activity of looking. Because we can see only what we know how to look for, it is these Schemata (together with the information actually available) that determines what will be perceived . . . The outcome of the explorations--the information picked up modifies the original schema. Thus modified, it directs further exploration and becomes ready for more information. (p. 20-31)

Neisser then focuses on the role of the cognitive structure of schema in directing controlled attention to particular features of the environment which in turn modify the schema which will then redirect its attentive process. The role of prior knowledge or training on the attentive processes is also emphasized in the selective attention model of Shiffin and Schneider (1977). In particular they distinguish between *automatic detection* which is primarily a function of practice and training and requires minimal processing resources and *controlled search*, a qualitatively different type of cognitive process demanding considerable processing capacity. While the exact mechanism of selective attention is not yet resolved, the models of both Neisser and Shiffin and Schneider are of direct relevance to instructional design and research as they emphasize selective attention as an interrelated function of the display, the cognitive structure, and prior experience of the subject with the task.

As a result of this information processing emphasis on the role of the cognitive structure in mediating attentional processes, instructional strategies need address not only features of the display but also the cognitive framework of the learner. Thus the attention mechanism of a learner with a highly developed cognitive schema as in the case of a learner with a great deal of prior knowledge or experience with the content will be very different from that of a naive learner and is likely to require qualitatively different types of instructional support.

Further as a result of the schema-display interaction over time, the nature of the attentive process will change as learning proceeds. From a research perspective the need to conduct studies on "tuned" rather than naive learners in order to generate relevant experimental conclusions has been emphasized by Cronbach and Snow (1977). Future research efforts on instructional methods need to carefully define the task in terms of the learner's prior experience or familiarity with the material and be sensitive to qualitatively different attentive processing mechanisms in naive compared to practiced subjects.

Attention: Locus of processing Activation

Attention and Directed Cognitive Activation

From an instructional design perspective, selective attention may be directed by supplantation, instructional direction, or delegated to learner controlled strategies. Overt attention directing techniques such as various forms of attribute isolation i.e. underlining, arrows, color cues, or media specific effects such as zooming in on important visual detail, use of quick cuts to diverse sequences, or animation may supplant learner-generated selective attention to important features of the instruction by physical cuing. The ubiquitious use of such display cues may not always be the optimal long term attention directing strategy.

The continual exposure to such supplanting treatments may in fact exert a long term debilitating effect. By continually performing the necessary cognitive operation i.e. drawing attention to relevant features for the learner, he or she does not get the opportunity to develop that processing strategy for him or her self. This seems especially crucial with younger learners whose processing deficits are largely developmental rather than aptitudinal. It has been informally noted by preschool and kindergarden teachers that the attention span of young children exposed for several years to "Sesame Street" is much poorer relative to pre "Sesame Street" populations. By prolonged exposure to the dense attention-directing features of the program, young children may not get opportunities or motivation to develop internal attention-directing processing on their own. Future research needs to confirm and define the potential debilitating long term effects of the supplementation approach.

Instructional-directed attentive strategies such as inserted questions (Andre, 1979; Rickards, 1979), pretests (Hartley & Davies, 1976), and behavioral objectives (Melton, 1978) may draw attention to relevant instructional features indirectly by requiring the learner to process specific elements of the material in order to complete the task. It has been found that the position of these adjunct strategies in an instructional sequence directs attention to relevant versus incidental material (Rickards, 1979). Preinstructional strategies such as prequestions, behavioral objectives, and pretests direct learner attention to those relevant elements featured in the preinstructional tasks at the expense of other information. In contrast, strategies which occur following the instruction i.e. post questions, have been shown to facilitate attention to both relevant and incidental information, a phenomenon originally described by Rothkopf (1965) as a "mathemagenic effect".

Instructional-directed attention may also be mediated by strategies which directly affect the cognitive schema. A recent review by Mayer (1979) of the effects of advance organizers has concluded that a specific organizer is effective only to the extent that it provides a cognitive linking structure between the instruction and the cognitive structure of the learner. If the learner is already familiar with the content, the organizer will not effect the learning outcome. Therefore without careful matching between organizer and prior experience of learners an overall "no significant difference" effect will result as has been concluded by Barnes & Clawson (1975). Mayer concludes "It must be noted, first, that organizers are always relative to the particular learner and subject matter. A passage that serves as an advance organizer for one learner may not be needed for another learner" (p. 382). It may be that one mechanism whereby an organizer can facilitate learning is by shaping the attentive process indirectly by enriching schema which in turn can seek more relevant information from the instruction.

Effective instructional-directed strategies which exert a schema-mediating attentive directing effect could be designed into the context of the instruction itself as well as in such adjunct strategies as advance organizers. Careful sequencing of content in a spiral or elaborative structure as described by Reigeluth (1979) could exert an attention directing effect by manipulating the cognitive structure of the learner. By providing an initial overview with successive indepth elaborations the learner's schema can be selectively structured in a way to optimize the ongoing attention to and assimilation of successively complex presentations of information.

As a third alternative, the appropriate direction of attention to relevant instructional features may be delegated heavily to the learner in a learner-control approach. As mentioned above, this strategy is most appropriate with learners whose attentional cognitive processing operations are well developed or whose prior experience with the content gives them highly enriched schema to direct productive attentional search. Such circumstances would vary both among learners and within a particular learner as a function of his/her previous experience with the content.

Instruction vs. Learner Control of Attention: Research Evidence

Unfortunately much of the research which compares instructionally provided, learner generated, and control strategies which could reasonably have attention-directing potential has been on college populations where the homogeneous aptitudinal mix precludes relevant evidence as to interactions between degree of instructional direction and learner aptitudes. When comparing subject-generated to experimental-provided underlining of sentences in text among a college population, Rickards & August (1975) found that total recall of material was best facilitated by subject-generated underlining when subjects were free to underline any sentence of their choosing (i.e. learner control). In contrast, subjects who were directed to underline a sentence of high structural importance or provided the underlined material did not achieve significantly better than subjects given 'read only' instructions. More recently in comparing different learning outcomes resulting from use of various organizational aids (topic sentences, headings, related and unrelated sentences) which were either learner-generated or instructionally provided, Lucas & Divesta (1980) reported outcomes to vary depending on a number of factors. Recall of passage structure as reflected by a hierarchy test did not vary among the different aids which were instructionally provided but did among those which were generated by the subjects. Their results indicate that future research will need to make finer distinctions between instructional or learner generated strategies in terms of the desired outcomes of instruction.

Working Memory--Rehearsal and Chunks

Evidence from a variety of recall and recognition studies suggests two types of memory--one a working or active memory characterized by a limited capacity and rapid information decay but with active data manipulation capability and the other a long term memory with much larger capacity for storage and more permanent maintenance of information. Working memory, often referred to as Short Term Memory has traditionally been conceptualized as a separate black box in the information processing model. Shiffrin and Schneider (1977) however conceptualize it as an activated subset of long term memory stating that

> Short-term store is the labile form of the memory system and consists of the set of concurrently activated nodes in memory. . . . STS has two somewhat distinct roles. The first is the provision of a temporary storehouse for information currently important to the organism. That is it acts as a selective window on LTS to reduce the amount of information for processing to manageable proportions. The second role of STS is the provision of a work space for decision making, thinking, and control processes in general. (p. 157)

Working memory then plays a crucial role in cognitive processing providing an active site for data manipulation. In reading a sentence, for example, comprehension is dependent on sufficient active storage of the words from the beginning of the sentence to relate to those at the end. In solving a problem enough data must be kept in active memory to allow productive manipulation of information in order to produce a solution.

Maintenance of information in working memory is primarily a function of active rote rehearsal as well as the meaningfulness of the stimuli. In tests of immediate recall of low meaningful stimuli such as random numbers or letters, typical retention ranges around seven items (Miller, 1956). However if such individual items as letters for example are recombined into larger meaningful units such as words, the learner can recall seven of the larger units. Thus the expression "chunks" has been employed to describe the storage capacity of working memory at around seven chunks of information, each chunk being a function of the meaningfulness of the information.

Meaningfulness is a relative term and reflects prior experience of the learner. Based on the work of deGroot (1965), Simon (1979) and coworkers conducted a series of experiments on chess players which dramatically illustrated the effects of prior experience on memory outcomes. Chess players of varying ability levels i.e. beginner, class A, and master were given brief (5 second) exposures to mid-game chess boards containing 12 to 26 pieces and then asked to reconstruct the board from memory. Within 3-4 trials, masters attained criteria while beginners took considerably longer--up to 14 trials in one instance. In repeating the experiment using the same number of chess pieces which were placed in random order on the board, master performance was decremented to that of the beginner. From his vast repertoire of plays in long term memory a master is able to look at a chess board briefly and cluster pieces into a few meaningful chunks which he can then store in working memory. Beginner's chunks on the other hand consist of almost piece by piece units and thus are much less efficient memory units. If the meaningfulness of the symbol arrangements is degraded by random placement of pieces, the master's seemingly unlimited capacity becomes equivalent to the beginner's.

In what ways can the effects of rehearsal and chunk size on working memory be optimally manipulated in the design of instruction? Again, instructionally based strategies can adopt either a supplanting or instructional-directed approach. A supplanting strategy would circumvent the capacity limitation of working memory by performing the memory function for the learner and might be most appropriate when the memory component of the learning task is essentially irrelevant to the desired objective or skill. By providing a continuous display of the information needed to complete a task or solve a problem or allowing the learner to do so by using some recording device rather than performing the operation without external memory support, the working memory could be circumvented and capacity freed for other tasks. By building a very redundant audio and visual sequence into the instruction an external rote rehearsal could be simulated. The efficacy of such a strategy might be offset by failure of learners to attend the rehearsals after a few iterations.

Instructional directed strategies would include orienting tasks which encourage learner processing that maximize working memory capacity. Some examples might include careful structuring of content so organized to allow necessary processing on one limited set of data which does not exceed short term capacity before proceeding to the next set. Such design sensitivity to information overload is especially crucial in dual channel externally paced media such as televised or slide-tape presentations where dense information displays may proceed too rapidly for effective cognitive assimilation. In comparing the instructional efficacy of pictures of varying degrees of realism, Dwyer

(1978) reported that highly realistic pictures were less effective than simple line drawings especially when presented via externally paced media. He felt the realistic visual provided too many cues to be effectively assimilated in externally paced presentations. Another orienting task which might facilitate working memory retention would require rote rehearsal of information such as directions to practice aloud the correct spelling of a difficult word. A third alternative would be to structure the lesson so as to encourage overlearning of lower hierarchical task levels so that potential chunk size could be increased and thus working memory capacity enhanced. The rote nature of some of these suggested tasks could have negative attitudinal effect on the learner. The designer needs to be certain that the retention of the information is essential to the desired learning objective. The above proposed supplantation and instructional directed strategies require research efforts to define the circumstances under which they would be most efficacious.

Long Term Memory and Depth of Processing

The nature and control of information storage in long term memory has been the focus of a considerable amount of research effort. Unlike working memory, long term storage (LTS) is considered to be of much greater capacity and the stored information to be of more permanent duration. Information transfer from sensory receptors and working memory into LTS is considered to be a function of the processes of rehearsal and encoding as well as properties of the stimulus itself.

Unlike working memory which is optimally maintained by rote rehearsal of chunks, long term memory retention is better served by a more "meaningful" type of rehearsal referred to as elaborative rehearsal (Craik & Watkins, 1973). During the past several years much interest in the psychological literature has explored such rehearsal processes and led to a concept termed "depth of processing" (Craik & Lockart, 1972). The experimental basis of the depth of processing concept typically compares the retention of material which is manipulated by the subject according to the following design:

A. Surface, feature, or syntactic tasks in which the subjects:
    1. look for words containing particular letters (Hyde & Jenkins, 1969)
    2. identify the type of script used (Craik & Tulvin, 1975)
    3. classify faces by sex (Bower & Karlin, 1974)
    4. scan pictures for small inserted x's (Bransford, Nitsch & Franks, 1977)

B. Deep, "meaningful" or semantic counterparts to the above tasks where subjects classify:
    1. words according to their pleasantness
    2. faces according to honesty
    3. a room of furniture according to function

C. Control conditions where subjects are presented the stimuli with intentional recall instructions but no other orienting tasks.

Results consistantly demonstrated that more "meaningful" or deeper processing tasks resulted in greater retention or memory for the stimuli.

This memory facilitation effect of orienting tasks that require "deeper level of processing" by learners has obvious implications for instructional designers. Adjunct questions or other orienting tasks requiring the learner to manipulate the content in some semantic or evaluative context seem indicated. However some modifications of the original depth of processing construct refines these design implications.

Depth of Processing--Eight Years Later

As research on the depth of processing model proceeded, two instructionally relevant directions emerged. First it was demonstrated that the so called "shallow" feature identification tasks i.e. identification of capital letters in a series of words were, in fact, much better facilitators of surface feature recognition criterion tasks than were deeper levels of processing tasks (Stein, 1978). Thus the efficacy of a particular adjunct task was more a function of the nature of the criterion than of any intrinsic value of particular types of orienting tasks. Therefore when planning adjunct instructional tasks, the designer needs to consider the nature of the expected or desired outcomes and plan a task which will be the most congruent thus facilitating what Morris, Bransford & Franks (1977) term transfer appropriate processing. For example if feature or pattern recognition is a desired behavioral outcome, a task that demands a similar behavior will be more appropriate than a semantic or deeper level task.

Secondly, the depth of processing approach resulted in a great deal of attention directed to the effects of different types of adjunct orienting tasks to the neglect of cognitive activation potential of the stimuli itself. Instructional-directing cognitive processing can result not only from adjunct orienting tasks but from contextual manipulation of the instruction. For example a study by Kunen, Green & Waterman (1979) reported the memory enhancing effects of perceptually degrading visual stimuli. The authors found that partially degraded images made up of progressively separated dots took longer for subjects to process and resulted in greater recall memory than clear line drawings. When the dots were widely separated and the resulting image very unclear, learner capacity to achieve a meaningful interpretation and memory storage of the image was exceeded and performance declined. A curvilinear effect was demonstrated where partially degraded materials were better recalled than were very clear or highly degraded pictures. This rather counterintuitive effect contrasts directly with "traditional views which assume that memory for stimuli be enhanced as the stimuli increase in clarity, completeness, and concreteness. The nature and quality of the perceptual operations subjects use to analyze stimuli apparently are potent variables that, under appropriate circumstances, may be more important in determining memory than a stimulus attributes such as concreteness" (p. 582).

Alternative Memory Structures: Encoding & Storage

The encoding of information from display to incorporation into the learner's cognitive structure is the linking transformation between the external stimulus and its representation in long term memory. The extent to which the depth of processing tasks were effective may be a function of the type of encoding which resulted from the manipulations of the stimuli. The exact nature of informational storage in long term memory is not resolved with various theories suggesting more than one type of internal representation. Gagne & White (1978) have recently reviewed the instructional implications of various types of memory structures and learning outcomes including episodic, propositional, and imagery-based memory.

Tulving (1972) distinguished a special type of memory he coined *episodic* in which storage of items is tied to autobiographic events. Memory of personal experience is a feature of episodic storage and to the extent that learning can be made an active personal experience through field trips, laboratory exercises, simulations, and internships, episodic memory is activated (Gagne & White).

In contrast, semantic memory refers to acquired verbal information and concepts which are not tied to particular time sequences or events as is episodic memory. Semantic memory systems are characterized by their highly categorical properties which have been modeled by propositional networks of interrelated nodes. Learning is conceptualized as a process which creates greater complexity of internode structure. From an instructional perspective, the semantic memory storage calls for careful contextual attention to structuring of content. This is especially important when the material is new to the learner. Some provision for meaningful encoding into the schema is indicated. Advanced organizers, careful sequencing of content, or heavy use of analogy are all strategies which may facilitate acquisition of semantic information (Mayer, 1979; Schustack & Anderson, 1979).

A third type of memory is that for images. In comparing recall of images to verbal representations, it has been generally accepted that pictures or images are much more memorable (Pressley, 1977). The exact nature of image encoding has been subject to debate. Introspective reports and a variety of studies (Shepard & Metzlar, 1971; Kosslyn, 1976) seem to support an isomorphic type of internal encoding of images which are not "snap shot" types of representations but are encoded in a distinct format from the propositional networks described above. Paivio (1978) has suggested a dual coding approach to symbolic representation in memory: one system specialized for processing nonverbal information and the other for information of a semantic nature. The two systems are independent but closely interrelated so that one system can readily activate the other. Anderson (1978) however has argued that propositional accounts of encoding could explain the various imagery studies and that a single encoding mechanism is more parsimonious than several different types of storage.

In relating the design application of pictures and diagrams to instruction to the debate on the nature of internal imagery encoding, Winn (1980) suggests that different types of pictures may be encoded differently depending in part on how the learner anticipates using the information. If the task involves recall and/or manipulation of spatial elements, the information may be encoded by imagery whereas if a comparison of semantic distance or problem solving is required a semantic or propositional type of encoding may be utilized. Certain types of pictorial displays, such as realistic pictures versus logical diagrams may be more isomorphic to the internal representation dictated by the task and thus be better facilitators of specific learning objectives. The exact nature of such efficacious matches needs to be explored in an information-processing context.

Gagne & White (1978) emphasized the need to provide instructional linkages between the memory systems in order to strengthen memory storage of information. Thus linkages between imagery and semantic memory systems can be encouraged by instructional-directed strategies that provide textually related images or encourage learners to form their own. Various learning strategy programs to be discussed below prescribe specific study techniques such as networking or imagery on a rationale of matching learner encoding of information to various long term memory representations.

A supplantation strategy applied to LTM mechanisms implies that the material will not be assimilated into the cognitive structure--in other words it would not be learned. Such approaches may be more appropriate than are commonly applied. A careful assessment of the desired learning outcome may find that in learning a complex algorighmic skill such as computer programming, attempts to stimulate LTM assimilation of specific programming commands are counterproductive or at least irrelevant to acquisition of the programming skills. A more appropriate approach may be to provide clear descriptions and examples of programming operations and require learners to develop a workable program. Such an approach relates again to the transfer appropriate processing and suggests the use of memory supports to supplant content necessary to achieve the desired skill.

Retrieval

All learners have the experience of "knowing" something but being unable to call it up from memory. It is apparent that effective retrieval is dependent on utilization of adequate retrieval schemes or cues during the acquisition process. Whether such cues exert their effects at the encoding stage or provide an independent retrieval access is not known as it is impossible to empirically disentangle encoding from retrieval processes. Whatever is the case, it has been demonstrated that effective retrieval strategies must be imposed on the material to be learned at the acquisition stage (Bransford, 1979).

One ancient retrieval or mnemonic strategy is the use of visual mnemonics reported over 2000 years ago by the Greeks (Higbee, 1979). As an associative technique it has been found that visual mnemonics are most effective when the two items to be recalled together are visualized in active interaction with one another and in as vivid an image as possible. For example, if associating cat and truck, an image of a white Persian cat driving a red pickup will be more effective than visualizing a generalized cat next to a generalized truck. For recalling serialized lists, the ancient method of loci has been found to be effective whereby one remembers items by imagining them placed in distinct and familiar locations. For example the items might be imagined as placed in different rooms throughout one's house and retrieved later by an imaginary trip through the house. A recent report by Roediger (1980) comparing various mnemonic strategies found that link, pegword, or loci strategies permitted much better serialized recall than did elaborative rehearsal or formation of separate images.

Memory enhancing images could be provided for the learner in a supplanting approach or their formation could be induced by instructional directions. Some research evidence supports the benefits of subject-generated images although the trend is not without exceptions (Higbee, 1979). Subjects with developmental or aptitudinal imagery-producing deficits might benefit more from provided images.

Such mnemonic strategies as the method of loci or pegword seem most applicable to relatively low level memory tasks. The role of visual imagery in higher level creative processes of both an artistic and scientific nature is not known but has been discussed by Shepard (1978) in an historical account of imagery mediation of major artistic and scientific creative achievements.

This brief outline of major instructional processing events with a few suggestions as to ways they might relate to the learning process suggests the complexity of building relevant design principles based on cognitive processing models. Because most stimuli of instructional relevance such as advance organizers, questions, and pictures are perceived several levels of magnitude above the typically briefly exposed simple stimuli which form the basis of the informational processing paradigm, it is likely that any one instructional methodology interacts at a variety of cognitive processing levels. Having briefly presented an overview of ways that instructional strategies of supplantation or instructional direction could interface with the various cognitive processing stages, the remainder of the paper will discuss in some detail the third alternative--learner control.

Learner Control and Learning Strategy Training

Several recent reports have investigated the effects of externally applied learning strategy programs which attempted to instruct students in relevant metacognitive procedures which they could independently apply to learning situations. One strategy developed and tested by Dansereau and coworkers (1979) is designated by the acronym MURDER and includes: Mood to study; reading for Understanding; Recalling material; Digesting material; Expanding knowledge by self inquiry: and Reviewing mistakes. Particular emphasis was placed on the recall strategy in which students were directed to translate the material into an alternative symbol system by one of three processes: (1) paraphrase/imagery (2) networking or (3) analysis of key ideas. For paraphrasing/imagery pupils were directed to transfer material into natural language or pictures. In networking, materials were transformed into specific node-link maps analogous to long term memory network models of information storage. Analysis of key ideas was a structured alternative to the networking strategy.

The effects of these strategies were evaluated in a study comparing pre and post test outcomes for participants in a one semester learning strategy training course with 'no treatment' control groups. Because of nonrandomization of assignment and selfselection bias a rigorous interpretation of the results is not warranted. However the data from this study as well as a previous study by Holley, Dan Serean and coworkers (1979) did suggest positive effects of the networking strategy applied to lengthy textbook passages on "main idea" assessment items, i.e., essay and concept items but not on "detail" assessment items, i.e., multiple choice and short answer responses. Thus as in the Lucas and Divesta (1980) study different strategies apparently will exert different effects on different outcome measures indicating need for greater sensitivity to transfer appropriate strategies.

Learning Strategies and Learner's Aptitudes

Thorndyke and Statz (1980) explored knowledge acquisition from maps in a study in which learning procedures utilized by "good" learners in an initial experiment were taught later to a secomd set of learners. Thus the learning strategies were empirically derived on the basis of introspective data from the initial group of successful learners. In the first experiment, learners were exposed to a map in a series of study-test trials with instructions to "learn" the map so as to be able to reproduce it. As subjects studied, they were instructed to verbalize their thinking processes which were recorded and later organized into learning procedures. The learning processes were categorized into generalized procedures of attention, encoding, evaluation, and control. These procedures were then correlated with "good" and "bad" learning outcomes on the map learning task. It was found that with regard to attentional processes, good learners took a systematic approach, partitioning the map into segments and using systematic sampling of elements more frequently than poor learners. On later trials, memory-directed sampling wherein learners focused attention on unlearned elements was more heavily used by good learners. With regard to encoding stragegies, subjects differed little in verbal learning procedures. However effective learners used frequent and varied spatial learning strategies. Finally, while all learners evaluated their progress, good learners evaluated unlearned elements, ignoring information they already knew while poor learners spent their time confirming that they already knew certain information. Further, good learners were more accurate in their evaluation of what they did and did not know than poor learners.

Based on the map learning strategies of the "good" learners, a training program was developed whereby three groups of subjects were exposed to (1) the use of the effective procedures (2) the use of procedures uncorrelated with performance and (3) no training. After an initial pretest consisting of three study-recall trials, a 20-minute training program was followed by two practice trials, a review of procedures, and a test.

The results indicated significant improvement for effective procedures groups although an interactive effect revealed that high visual ability subjects were able to utilize the strategies efficiently, lower ability subjects improved no more than subjects in the other groups. Interestingly, there was no correlation between visual memory aptitudes and effective procedures used in pretest trials indicating no strong relationship between aptitudinal strength and "natural" utilization of that skill as an effective learning strategy. Therefore a need to overtly direct learners to capitalize on their aptitudinal strengths is indicated, especially for learners of apparently high aptitudes but poor performance outcomes.

Learner Control and Computer Assisted Learning

In addition to the learning strategy programs which attempted to provide subjects with a variety of qualitatively different metacognitive instructional interventions, learner control has been built into computer assisted instructional systems. Tennyson and Buttrey (1980) report a comparison of outcomes varying the locus of instructional control, i.e., in the student or in the computer assisted learning program with the presence or absence of feedback as to pupil progress and instructional needs. When the program maintained control, the number and sequence of examples illustrating given concepts were adaptively adjusted in terms of pupil pretest and instructional progress. When learners maintained control, they were free to adjust the numbers of examples and sequence of concepts. Feedback in both instances consisted of informing pupils of their learning progress at the completion of the pretest and after each response. Confirming previous results, the learner control group without feedback did not reach criterion performance, terminating the instruction before they achieved mastery. Students under program control and learner control with feedback all reached criterion with the learner control group completing instruction in significantly less time than the computer control group.

This study seems to indicate that while learner control strategies are not successful when pupils make independent decisions as to their instructional needs, with feedback their performances become equivalent to subjects exposed to computer control conditions and in less time. It may be that the adaptive strategy which was quantitative rather than qualitative in nature would not interact with aptitudinal differences. Future research needs to distinguish between learner control which is based primarily on quantitative adaptation such as the number of examples and that which incorporates qualitative interventions such as imagery or semantic representations of information.

Summary and Conclusions

It has been the position of this paper that relevant generation of instructional design principles which will provide an accurate predictive basis on which to produce effective instruction will only result from an instructional design theory of sufficient comprehensiveness to allow inclusive hypotheses generation. In keeping with the cognitive psychology perspective, such a theory will link instructional methodology to learning outcomes in terms of cognitive operations which interface between the external stimulus and the outcome called learning. By understanding the psychocognitive mechanisms of particular instructional attributes, sufficient construct validity may be achieved to permit reliable prescriptive instructional interventions.

One approach whereby instructional design strategies may be linked to information processing stages is to identify a continuum of loci of cognitive processing including supplantation of cognitive operations by the instruction, activation of cognitive operation by manipulating the instructional directions, and total learner control. A negative relationship between the degree of instructional assumption of cognitive processing operation and general aptitudinal ability was suggested implying that high ability learners be exposed to a minimal amount of instructional intervention designed to direct or activate specific cognitive pathways.

Finally with development of the cognitive processing perspective, instructional technology research may return to exploration of media this time capitalizing on the psychological potential of such media-specific visual effects as zooming in, rapid cuts, animated sequences or slow motion. Differences in optimal design strategies for highly pictorial versus highly textual versus visual-audio systems or for self paced versus externally paced media can be defined in terms of cognitive processes.

In order to achieve psychologically relevant hypotheses of instructional design, an integration of cognitive information processing theory with instructional development approaches needs to be realized. Incorporation of the paradigms from a broad spectrum of psychological research fields into instructional theory will require an interdisciplinary communication between such areas of research as linguistics, cognitive psychology, social and personality psychology, and learning theory. As the information processing model continues to evolve, instructional design theory is likely to become more complex and encounter many inconsistencies in its applications.

Nevertheless, it is only by a conscious interdisciplinary effort to integrate information from other fields to formulate a cognitive basis of instruction that local theories or skeleton principles to which exceptions may be the rule will be realized.

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The Roles of Attention, Instruction, and Medium-Related Skills in Children's Television Viewing

Marc Braverman
University of Wisconsin-Madison

Rosemary Lehman
Monona Public Schools
Monona, Wisconsin

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THE ROLES OF ATTENTION, INSTRUCTION, AND MEDIUM-RELATED SKILLS IN CHILDREN'S TELEVISION VIEWING

This study concerned the cognitive aspects of children's watching of television. Educational research attention has recently turned toward attempting to understand the communicative elements in the television medium and the cognitive processes demanded by it (Collins, 1975; Salomon, 1979). Salomon in particular has stressed the role that symbol systems, and the viewer's capabilities for interpreting them, play in the reception of a television message.

Salomon (1979) makes the interesting speculation that television allows for a very wide variability, relative to other media such as print, in the skills and processing behaviors one may engage in: a viewer can pay close attention to cues and engage in elaborative cognitive activity, while conversely he or she can minimally process the content for the straightforward narrative (or other thematic) information. Salomon argues that since the pictorial symbol systems are, in a representative sense, close to one's internal interpretive schemata, the required mental skills are *potentially* not of a difficult nature. Thus we can see the crucial importance of attention to this process. However, for picking up more than minimal information or for comprehending difficult coding elements, certain decoding skills are indeed required, and we should not necessarily expect children to have mastered them.

This study addresses the following questions: To what degree is processing capability mediated by one's attentional set, as opposed to skills that one brings to the viewing situation? If attention *is* a significant mediating factor, is this true across various *kinds* of information one can receive from the stimulus? Is instruction more necessary for some kinds of information than for others? Furthermore, what is the role of abilities in this process--both spatial and verbal?

Method

Design. Subjects were 4th- and 5th-graders. They were randomly assigned to treatment condition. Three levels of classroom instruction (pictorial elements, characterizations, and control) were factorially combined with two levels of pre-viewing directions (directions and no directions) to yield six cells. At this point, ability data have not been analyzed, but regression coefficients will be calculated within each cell for various verbal and spatial abilities and for television-viewing behavior. This will allow the presence of aptitude-treatment interactions to emerge.

Instruction. For the children receiving instruction, a five-day classroom unit was presented on one of television's communicative forms, either "pictorial elements" or "characterization". These units are drawn from a program entitled "Centering Television", produced by the second author (Lehman, 1980). The entire program comprises ten elements and hands-on video experience, and has been successfully implemented in Madison area schools. Each element-unit involves selected TV program viewing, group discussion, essay writing, speakers, and experience with the element across other media. Insttuction was carried out by the children's regular teachers. The control classes did activities related to television, reading, and communications, but did not deal with communicative aspects of television per se.

Materials. The verbal abilities measured were vocabulary and sentence completion. Spatial abilities measured were spatial visualization, spatial orientation, spatial scanning, and visual memory. All measures were group-administered, timed paper-and-pencil tests. Amount of television watched was measured by a 3-page checklist.

The stimulus for the posttest was a narrative videotape that had been shown on commercial television 1½ years before the experiment took place. The tape is in color and runs for one half-hour. For the dependent variable, three multiple-choice subtests were developed: comprehension of the story line ("comprehension"), understanding of the use of visuals for effect ("pictures"), and understanding of characterizations ("characters"). Each of the items in the latter two subtests was based on a 30-45 second clip from the film that was shown to the children just prior to presentation of the item.

Procedure. All children completed the ability measures in their classes. The following week, they received instruction according to their assigned treatment condition. There were six classes altogether, two for each treatment. To control for teacher effects, the six teachers in the study rotated classes, so that each teacher taught each treatment in the course of the week. In the third week, children took the posttest in randomly determined groups of 13. For all groups the experimenter provided a brief introduction, but in the directions condition he also instructed the children specifically to attend to visuals and characterizations.

Results and Discussion

Data collection for the study took place in February 1981, so only a few preliminary analyses have been done. For each subtest, the means and standard deviations for the various instructional conditions are presented in Table 1. Simple contrasts (Experimental treatment mean minus Control mean) show the following results: (1) Scores on the pictures subtest were significantly improved relative to control by instruction in pictorial elements (p=.03), but not by instruction in characterizations. (2) Scores on the characters subtest were not significantly improved relative to control by instruction in either pictorial elements or characterizations. (3) Attentional directions at the time of testing did not raise either the pictures score or the characters score relative to control (no directions). Complex comparisons have not yet been performed on the data, nor have any analyses relating to the ability variables.

Although an extended discussion will have to wait for a full analysis of the data, we can make some preliminary observations. First, on the pictures subtest, the pictures instruction showed a significant effect relative to control. This result indicates that children need instruction in pictorially-related elements in order to apprehend that form of information. Since directed attention did not produce the same learning effect, our results suggest that in order for us to increase children's comprehension of what is happening visually in a presentation, it is not enough simply to direct their attention to that channel. We must teach them something about the forms that information will take before they develop true competence.

For the characters subtest, neither instruction nor viewing directions produced substantial gains in children's scores, relative to control scores. The distinction between this and the pictures subtest might be due to differences in the learning processes involved. Those processes relevant to the characterization lessons--observation and the drawing of inferences regarding characters' personalities and motivations--involve elaborating on information already received rather than acquiring new information in relatively unfamiliar forms, as is the case in the pictures condition. Thus it might be more difficult to stimulate children to produce this form of elaboration--they have already acquired habitual levels of processing story content. However, at this point all our conclusions must be considered tentative.

The viewing directions at the time of testing did not produce any significant changes in comprehension. Nevertheless, most previous research supports the influence of one's attentional set on information acquisition. The discussion prior to viewing may not have produced an adequate shift in the attention patterns children used. As alternatives, future studies might investigate the inserting of directions into the program itself or the use of priming questions, addressing the content directly.

At this point in the analysis, no firm conclusions are offered. Complex interactions among the treatment conditions remain to be inspected. Further analysis will also reveal the role that viewer abilities play in the learning process. These will be completed in the near future.

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Table 1

Mean Scores of Children on Each Posttest in Each Instructional Condition

	Pictures[a]		Characters[b]		Control[c]	
Test	Mean	S.D.	Mean	S.D.	Mean	S.D.
Comprehension[d]	9.92	1.99	9.86	1.87	9.74	1.92
Pictures[e]	7.46	1.77	7.29	1.63	6.81	1.82
Characters[f]	8.27	1.89	7.98	1.82	8.62	2.21

[a] _n_ = 52

[b] _n_ = 51

[c] _n_ = 53

[d] Maximum score = 13

[e] Maximum score = 12

[f] Maximum score = 12

ED207492

TITLE: Visual Learning Stimulus Considerations: Concept-Related Graphic, Arbitrary Graphic, and Verbal Label Symbols

AUTHOR: Martha L. Brooke

IR009659

ABSTRACT

Brooke, Martha L. Visual learning stimulus considerations: concept-related graphic, arbitrary graphic, and verbal label symbols. Presentation given for the RTD/DID joint session on "ID & Messages from Research" at the AECT Convention, Philadelphia, April 1981.

This presentation concerned the designing of visual learning stimuli, a step within the systematic approach to instructional development. Decisions regarding the design of learning stimuli are made following task analysis and instructional event decisions and go beyond questions about display technology and teaching method.

The primary purpose of this presentation was to discuss the implications for instructional developers of the research on three types of visual symbols. The research, conducted by the presenter, compared the learning and long-term retention of concept-related graphic symbols, arbitrary graphic symbols, and verbal label symbols. The learning task was psychomotor response acquisition to these three symbols. The psychomotor response mode was used because it would be a different mode of response than the pictorial and verbal modes of the symbol stimuli. The research question, then, was which of three symbol stimuli--concept-related graphic, arbitrary graphic, or verbal label--would most rapidly bring a psychomotor response under control and would maintain control over time? Because of its inherent meaningfulness, the concept-related graphic was predicted to excell on both learning and retention measures. Because of a lack of previous research, there was no prediction between the arbitrary graphic and verbal label on either measure. Thirty-one subjects from a random sample of university students participated in the learning phase; twenty-six subjects returned for the retention test. Five psychomotor actions were used in this study with each action represented by a concept-related graphic, an arbitrary graphic, and a verbal label, making a total of 15 symbol stimuli. Stimulus familiarity was controlled for

by generating new symbols which included two-syllable nonsense words. As predicted, the concept-related graphic excelled among the three symbol types on both the learning and retention measures. The arbitrary graphic had a faster rate of response acquisition than the verbal label; but at the time of retention testing 7-8 weeks later, there was no significant differences between the arbitrary graphic and the verbal label symbols.

This presentation

- * discussed the range of visual symbol options (Wileman, 1980).
- * presented the attributes of three symbol types (i.e., concept-related graphic, arbitrary graphic, and verbal label).
- * discussed the implications of the research findings on learning and retention.

In summary, instructional developers were encouraged to look beyond a simplistic picture-versus-word choice of visual learning stimuli and to consider a rich range of symbol options, including arbitrary symbols.

Footnote

This talk is based upon the presenter's dissertation research which will be defended during the fall 1981:

Brooke, M.L. A comparison of learning and retention using concept-related graphic, arbitrary graphic, and verbal label symbols. (Doctoral dissertation, The University of North Carolina at Chapel Hill, 1981).

REFERENCE

Wileman, R.E. Exercises in visual thinking. New York: Hastings House, Publishers, 1980.

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The Effects of a Networking Information Processing Strategy On The Learning of Field-Dependents When Receiving Visual Instructional Information

James Canelos, Ph.D.
Post-Doctorate Researcher
The Pennsylvania State University
165 Suburban Drive
State College, PA 16801
(814-238-3421)

William Taylor, Ph.D.
Assistant Professor of Education
The Ohio State University
College of Education
121 Ramseyer Hall
Columbus, Ohio 43210
(614-422-5181)

IR009560

Abstract

The present investigation experimentally examined a networking learning strategy and its affects upon facilitating the learning of field-dependents. Also considered was the learning behavior of field-independents compared to field-dependents with a learning strategy. Learning behavior was examined under the condition of receiving a visual instructional program varying in levels of complexity. Two levels of learning performance were evaluated; list learning and spatial learning. The networking learning strategy did improve the learning behavior of the field dependents on both learning tasks. Visual stimulus complexity did not interact with field-dependence-independence or field-dependence plus strategy.

Rationale & Related Literature

The present research report describes in brief a research effort in progress. This research effort has resulted from a pilot study conducted in 1979 at The Ohio State University. The findings of the 1979 pilot were published in the volume 7, number 2, 1980 issue of Journal of Instructional Psychology, (Canelos, Taylor, Gates, 1980). The pilot study investigated the affects of visual display complexity upon the academic learning of field-dependents and field-independents as measured by performance on three different levels of instructional objectives. The results of the pilot study yielded significant effects indicating a complex relationship between the cognitive style evaluated, visual display complexity, and instructional objective level. The general conclusion implied from the results of the pilot study was that field-dependents were at a learning disadvantage when learning from complex visuals when required to perform on more difficult instructional objectives. Field-independents did not seem to show similar detrimental affects upon their learning behavior. The results and implications from the pilot study has initiated additional investigation involving the cognitive variable of field-dependence-independence and visual display complexity.

The present research in progress has added the operational variable of a cognitive learning strategy. The learning strategy in the present study involves an information processing strategy that relates to the internal cognitive organization of to-be-learned information. The strategy group subjects were trained to use an information processing technique which allowed them to manipulate cognitively (mentally) instructional information during the encoding and retrieval stages of memory. The specific learning strategy used in this study combined an imagery peg-mnemonic memory technique and a hierarchical retrieval memory technique. Bower (1972, in Tulving & Donaldson, Eds.) provides an excellent functional description of how these two memory techniques are hypothesized to operate to facilitate memory during learning. When using the imagery mnemonic the person has a consistent rule that gives direction as to what to do cognitively with each element to be memorized. The imagery mnemonic provides the learner with a place to file each item in the cognitive structure while also providing him with a set of retrieval cues. The imagery mnemonic will also give the learner a retrieval plan to facilitate the accessing of available memory store. This retrieval plan gives the learner a place to begin recall, a procedure for searching through the cognitive structure for the to-be-recalled item, and a way to know when to terminate recall if the item has been found or is not available. Similar to the imagery peg-mnemonic is the hierarchical memory technique. However, the hierarchical technique adds the additional feature of chunking related memory elements into a network of interrelated data. More specifically, the hierarchical technique consists of storing superordinant category labels and related subordinant elements in an interrelated structure resembling a network. Therefore, all relevant information would tend to be related in a single "chunk" or set consisting of the superordinant labels and subordinant related information. Retrieval then becomes a matter of recalling the "chunk" of information, and then searching through that chunk or set of elements for the specific recall element, rather than searching through all possible memory store. Additionally, the superordinant semantic labels would tend to relate logically to one another forming an overall network of interrelated data, or in essence a single large memory chunk of categorical information.

The cognitive style variable of field-dependence and field-independence is still under examination in the present study. Operationally, the learner's particular cognitive style is actually an innate or "built-in" learning strategy (Witkin, Moore, Goodenough, Cox, 1977). The cognitive style is assumed to develop by the interaction of the person's biological characteristics and his or her environment (Lewin, 1935). Once formed a particular cognitive style is quite "hard and fast" and is not likely to change. How the person interprets information from the environment and uses information is determined by the cognitive style. Therefore, the cognitive style operates analogously to an executive program in a computer (Gagne, 1977). The cognitive style is a metaplan system or a set of super plans the person will make operational when the opportunity occurs to acquire information, solve a problem or simply daydream (Miller, Galanter, Pribram, 1960). If the learner has a cognitive style system which is not adept at processing information in an effective way, he or she could be at a significant disadvantage in the learning situation. Attempts have been made to match instructional approach with cognitive style type. However, practical applications have not been readily available from the abundance of Trait-by-Treatment interaction studies, (Bracht, 1970). The primary researcher in the area of field-dependents and field-independents has been Witkin (1973).

The research efforts of Witkin and his colleagues have determined that there exists clear differences in the information processing capabilities between field-dependents and field-independents for different information processing tasks. The field-dependent (fd) is characterized as a global thinker, the fd confuses figure/ground relationships. The fd has difficulty abstracting relevant from irrelevant data in a visual percept. The fd tends to store conceptual data in general or overlapping categories rather than in discrete conceptual categories. The fd tends to have difficulty during encoding structuring information in a well organized way in memory. Such well structured memory systems in the learner's cognitive structure are believed to facilitate the recall of available information from memory (Tulving, 1968). On the other side of the continuum, the field-independent (fi) cognitive style can be characterized as an analytic perceiver of stimulus information. The fi is able to perceive relevant items as discrete from their background. The fi is able to restructure information in memory into well organized stable and clear clusters to facilitate later recall of available memory information. When experiencing a chaotic visual stimuli, the fi is able to impose a structure on the visual perceptual information.

It is likely that the perfect instructional environment could be designed for the fd and also for the fi based upon what is now known about their idiosyncratic learning behavior. Such "perfect" learning environments could be dsigned for any cognitive style. However, is this a plausible solution to the problem of an ineffective information processing style? It would seem to be more logical to present the learner with a set of learning strategies that would facilitate his or her information processing in any learning environment. Such content-independent strategies would relate to the cognitive mediation of information, or the actual cognitive manipulation of information by the learner during information processing. Specifically, a content-independent learning strategy should allow the learner to:

1) abstract relevant from irrelevant information,
2) assimilate to-be-learned information efficiently into the existing cognitive structure,
3) store new information in a stable and clear way distinct from data already in the cognitive structure,
4) recall available information from memory store when necessary.

A number of content-independent learning strategies, designed to allow learners to cognitively manipulate to-be-learned academic material, have been investigated with significant results, (Canelos, 1979; Dansereau, in O'Neil, Ed.; Bower, 1970; O'Neil, 1978, O'Neil, 1979; Bower, 1972, in Tulving & Donaldson, Eds.).

Research Design & Procedures

The present research effort further investigated the cognitive variable of field-dependents-independents. The information processing strategy investigated was a combination of the imagery peg-mnemonic and the hierarchical retrieval learning strategy. To simplify discussion, the information processing strategy used in this study will be labeled a "networking strategy." As was mentioned previously, the networking strategy was specifically designed to facilitate the abstraction process, the assimilation process, the storage of information in a stable and clear way, and the retrieval process.

The experimental design of this study implied a 3 x 3 analysis of variance. There were three levels of the cognitive variable:

1) field-independence (fi)
2) field-dependence (fd)
3) field-dependence + Networking Strategy (fdN)

The external variable was visual display complexity. The visual displays were presented as an academic instructional program via 2 x 2 slides and an audio tape. The academic program was about the parts and operations of the heart. There were three levels of the visual display external variable:

1) line drawings
2) detailed color illustration
3) color realistic photograph

Additionally, learning performance was evaluated on two types or levels of instructional objective:

1) a list learning task
2) a spatial learning task

Subjects who participated in the study were undergraduates from an instructional media course in the College of Education at Ohio State University. Each subject received five credit points toward their final grade in the course for their participation. There were (81) subjects in the study. Subjects were pretested to determine their knowledge levels in heart physiology, those with significant knowledge levels were dropped from the data pool.

Subjects received the Thurstons Closure test to determine their degree of field-dependence-independence. The subject pool was then split on the fd-fi variable into three groups fd, fi, and fd with the learning strategy. From this point subjects were randomly assigned to the three instructional programs. The programs were presented during one class session. Each of the instructional programs was presented at the same time but in different classrooms of course. The fd with the learning strategy group was trained on their strategy during the hour preceding the scheduled presentation of the instructional programs. Immediately following the instructional programs all subjects were given the test battery measuring list learning and spatial learning.

Results & Discussion

Two separate analysis of variance were computed with the resulting raw data. One analysis was done for the list learning task data and one for the spatial learning task data. The list learning data will be considered first.

The list learning task was measured by using the Terminology test from Dwyer's (1967) research work. The list learning task is relatively simple compared to spatial learning or conceptual learning. The learner was required to know the names of the parts of the heart for this task and demonstrated that knowledge by identifying the correct part name when given a brief description of that part. The learner did not have to know information about the relationship of a specific part to the set of parts, or the location of one part to another to perform well on the list learning task. Additionally, the part names were clearly labeled on each 2 x 2 slide, making part name learning relatively easy. Terminology test data yielded significant results on the field-dependent, field-independent, field-dependent networking strategy variable, F, $(2,72)=4.453$, $p < 05$. Follow-up testing with a Tukey test at .05 alpha indicated that the field-independents ($\overline{X}.=11.52$) learning performance was superior to the field-dependents ($\overline{X}.=8.63$) learning performance. However, the field-independents ($\overline{X}.=11.52$) performance did not differ from the field-dependents networking strategy ($\overline{X}.=9.07$) group. Although the field-dependent networking strategy mean ($\overline{X}.=9.07$) was greater than the field-dependent mean score ($\overline{X}.=8.63$) they did not differ significantly. The Terminology test data did not yield significant results for the complexity variable, F, $(2,72)=.09$, or with the interaction, F, $(4,72)=1.19$. The resulting data from the Terminology test indicated that the networking strategy improved the learning performance of the field-dependents since the field-dependent networking group did not differ significantly from the field-independent group. This result implies that the networking strategy facilitated the field-dependents to improve their basic information processing of academic information. It is likely that the complexity variable failed to be significant in this experimental setting since each slide had the relevant part name clearly labeled, making list learning a relatively simple task. Similarly, the interaction would not be significant if complexity effects were minimized by the part name labels.

Insert Table I and II Here

The spatial learning task was measured by using the Drawing test from Dwyer's (1967) research work. Spatial learning in this situation was a more complex learning than simple list learning. To perform well on

Table I

Terminology Test (list learning task)

Source	df	SS	MS	F	p
Visual Complexity (A)	2	2.745	1.373	.09	.50
fd/fd+S/fi (B)	2	130.671	65.336	4.453	.05
(A) x (B)	4	69.70	17.425	1.188	
Wg	72	1056.44	14.673		

Table II

Terminology Test, Means and Standard Deviation

	Simple Visuals	Illustration Visuals	Complex Visuals	
field dependent	$\overline{X}$ = 8.44 SD = 3.89	$\overline{X}$ = 7.78 SD = 2.78	$\overline{X}$ = 9.67 SD = 2.83	$\overline{X}$ = 8.63 SD = 3.30
field dependent strategy	$\overline{X}$ = 10.11 SD = 2.64	$\overline{X}$ = 10.00 SD = 3.83	$\overline{X}$ = 7.11 SD = 4.72	$\overline{X}$ = 9.07 SD - 4.07
field independent	$\overline{X}$ = 11.00 SD = 2.87	$\overline{X}$ = 11.89 SD = 4.23	$\overline{X}$ = 11.67 SD = 4.06	$\overline{X}$ = 11.52 SD = 3.78
	$\overline{X}$ = 9.85 SD = 3.35	$\overline{X}$ = 9.89 SD - 4.03	$\overline{X}$ = 9.48 SD = 4.37	

the spatial learning task the learner must acquire information about th part name, the parts specific location, and information about how the part relates to the other set of parts which make up the overall system of parts. The analysis of the spatial task data yielded significant results on the field-independent, field-dependent, and field-dependent networking strategy variable, F, $(2,72)=6.88$, $p<.05$. Follow-up tests using a Tukey measure set at .05 alpha found the field-independent group ($\bar{X}$.=11.82) to differ significantly from the field-dependent group ($\bar{X}$.=8.59). The field-independent group ($\bar{X}$.=11.82) did not differ significantly from the field-dependent networking strategy group, ($\bar{X}$.=11.15). The field-dependent networking strategy group ($\bar{X}$.=11.15) performed significantly better on the spatial task than the field-dependent group ($\bar{X}$.=8.59). The resulting analysis also found significance in the complexity variable, F, $(2,72)=10.17$, $p<.01$. Follow-up testing with a Tukey set at .05 alpha found that the line drawings produced a significantly better learning performance ($\bar{X}$.=11.96) than the color realistic photograph ($\bar{X}$.=8.15). The line drawing ($\bar{X}$.=11.96) failed to produce a significantly better learning score than the detailed color illustration, ($\bar{X}$.=11.44). However, the detailed color illustration ($\bar{X}$.=11.44) produced a significantly better spatial learning performance than the color realistic photograph. A significant interaction did not result in this experimental setting, F, = $(4,72) = .464$.

Insert Table III and IV Here

The networking learning strategy provided the field-dependent subjects with a procedure to allow them to more effectively acquire new information. This procedure, no doubt, facilitated their basic information processing of academic like instructional data by providing them with

Table III

Drawing Test (spatial learning task)

Source	df	SS	MS	f	p
Visual Complexity (A)	2	231.146	115.573	10.17	.01
fd/fd+S/fi (B)	2	156.222	78.111	6.88	.05
(A) x (B)	4	21.075	5.269	.464	.50
wg	72	817.778	11.36		

Table IV

Drawing Test, Means and Standard Deviation

	Simple Visuals	Illustration Visuals	Complex Visuals	
field dependent	$\bar{X}$ = 10.11 SD = 4.54	$\bar{X}$ = 9.22 SD = 1.86	$\bar{X}$ = 6.44 SD = 3.57	$\bar{X}$ = 8.59 SD = 3.72
field dependent strategy	$\bar{X}$ = 11.89 SD = 4.34	$\bar{X}$ = 12.11 SD = 3.59	$\bar{X}$ = 9.44 SD = 2.35	$\bar{X}$ = 11.15 SD = 3.60
field independent	$\bar{X}$ = 13.89 SD = 2.21	$\bar{X}$ = 13.00 SD - 1.94	$\bar{X}$ = 8.56 SD = 4.42	$\bar{X}$ = 11.82 SD = 3.78
	$\bar{X}$ = 11.96 SD = 4.01	$\bar{X}$ = 11.44 SD = 2.98	$\bar{X}$ = 8.15 SD = 3.65	

a specific method to abstract, assimilate, store and retrieve new information. The field-dependent without the aid of a learning strategy did not perform as well as those with the use of the networking strategy this was particularly evident on the more difficult of the two instructional tasks the spatial learning task. Another factor that is indicated is that the field-independent is using his own built-in information processing strategy which, in terms of analyzing new information, is quite effective. Recall that the field-independent is characterized as an analytic perceiver of information. The field-independent is quite adept at abstracting relevant from irrelevant information and the fi can organize information in a stable and clear way in memory to facilitate future retrieval. Since the fi's performance tended to be more effective than the fd's learning performance, it can be assumed that it is the effectiveness of their idiosyncratic information processing strategies which caused this difference. Most importantly, however, is the fact that by providing field-dependents with a learning strategy which facilitates their basic processing of information, their learning performance can be improved.

It is possible to generalize from these findings that learners can be provided with content-independent information processing strategies to facilitate their basic processing of information. Such content-independent strategies should relate to the cognitive manipulation of information by the learner. The learner can be taught to manipulate his or her abstraction, assimilation, organization and retrieval of academic information by the use of cognitive learning strategies which are content-independent. However, the present investigation is still preliminary in nature. Future research in this area should consider the refinement of a number of cognitive learning strategies that can be taught to learners in the early years of intellectual development. These cognitive learning strategies should be content-independent and should relate to the actual mental manipulation of information to facilitate the cognitive processes of abstraction, assimilation, organization and retrieval of academic information. A number of critical studies in the area of learning and cognition indicate that the research area of learning strategies offers promise in helping to improve the learning process, but much is left to be done.

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Student Learning of Concrete and Abstract Prose
Under Systematically Varied Media Presentations

James O. Carey and Michael J. Hannafin

Department of Educational Technology
Arizona State University

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Abstract

The purpose of this study was to examine the relationships among presentational stimuli (oral, visual, oral+visual), types of content (concrete, abstract), and learner ability (high verbal, low verbal). Third grade students (N=248) either heard a short story, watched pictures showing the same short story, or heard and watched a combination of the oral and picture presentations. Student recall of concrete and abstract information was measured by a 28-item, constructed-response test immediately after and again two weeks after the presentations. Students learned as much or more concrete and abstract information from pictures as from oral prose, and learned the most information from the combination of oral prose with pictures. Mislearning of concrete and abstract information, i.e., repeating the same incorrect response on both immediate and delayed tests, was higher from the picture presentation than from the oral presentation, and lowest from the combination of oral prose with pictures. Interactions were not found among types of presentational stimuli, types of content, and levels of learner ability.

Student Learning of Concrete and Abstract Prose Under Systematically Varied Media Presentations

Rationale and Purpose

Considerable research has been conducted in the effectiveness of various mediated presentation formats for communicating information to learners. In attempts to identify the so-called "best medium," researchers have studied exhaustively the characteristics of different types of media and different production styles and techniques within each type of medium. Salomon and Clark (1977), however, have suggested that the emphasis in media research is shifting from the medium itself to: (a) the types of stimuli in the mediated presentation, (b) the types of learning tasks taught in the presentation, and (c) the types of learners for whom the presentation is intended. In addition, research findings have suggested that what is actually "learned" under different mediated stimuli may not be demonstrated accurately due to the type of learning assessment employed. Since learning assessment has been typically defined relative to judged accuracy of specified responses, what is actually learned (or mislearned) is often undetected. The purpose of this study was to investigate the effects of progressively mediated presentations of prose information on student learning and mislearning of concrete and abstract information.

Presentational Stimuli

Practitioners in the instructional media field stress the value of the informational load that pictures can carry in communicating content to an audience. Research findings have demonstrated the positive effects of supplementing prose with pictures

(Levin and Lesgold, 1978), but the value of the picture part of the presentation is typically confounded with the effect of the verbal presentation. The few previous studies (e.g., Rohwer and Harris, 1975; Carey and Whitaker, 1980, Note 1) that have compared verbal with pictorial presentations of the same information have reported conflicting results, with most favoring the verbal presentations. However, results in many of these studies are confounded by poor control of the quality of the materials used, making performance differences attributable to production quality rather than to the potential of a given stimulus to transmit information. Questions of relative effectiveness of different stimuli can only be studied when alternate stimuli are not "preloaded" with different amounts of criterion information.

The first objective of this study was to compare learning from oral and progressively enhanced visual presentations of the same information.

Type of Information to be Learned

The learning task in this study was recall of verbal information. Paivio (1971) theorized that the most powerful factor that determines how well information will be remembered is its location on a continuum of concreteness-abstractness: the more concrete, the more easily remembered; the more abstract, the harder to remember. Paivio and Foth (1970) further hypothesized that the concreteness-abstractness of to-be-learned information interacts with the stimulus attributes of the presentational medium. However, the nature of such interactions is still largely unknown. The second objective of this study was to investigate whether the pattern of performance across pictorial and oral presentations is the same for concrete information as for abstract information.

Learner Variables

The ability to profit from pictorially versus verbally presented information has been demonstrated to interact with the age of learners (Christie and Schumacher, 1978; Guttman, Levin, and Pressley, 1977). Learner strategy predisposition has also been explored (Levin, Divine-Hawkins, Kerst, and Guttman, 1974). However, learner verbal ability was of primary interest in this study due to the concreteness-abstractness dimension of the learning task, and the comparison between verbal and visual stimuli. Willows (1978) found that low ability children were more picture dependent than high ability children. If this is true, then presentation formats emphasizing visual stimuli should result in findings of presentation by ability interactions. A third objective of the study was to investigate the effects of different stimuli on the learning of concrete and abstract information by high and low verbal ability students. The Total Auditory scale of the Stanford Achievement Test was used as the measure of verbal ability.

Methods of Assessing Student Learning

Test effects have been of continuous concern to educators. Rohwer and Harris (1975) reported that treatment effects were dependent not only on the type of media used, but on the means of assessing learning. Filan and Sullivan (1980, Note 2) found that students recall more information when tested in the mode (visual or verbal) in which they were instructed to recall the information. What students "learn" may often be a function of how learning is assessed and the evaluation standards employed to judge the correctness of the responses. The final objective of this study was to investigate the relationship between types of stimuli and information, and two assessment procedures: (a) a normal, objectives-based procedure using pre-specified standards of correctness and (b) an objectives-free procedure designed to measure what was recalled without regard for standards of accuracy.

Method

Subjects

The subjects for this study were 248 third graders from the three elementary schools in a middle class school district. The population was predominately of White racial background, with a significant minority of Spanish-surname students.

Materials

Five different information presentations were developed for the study. All were adapted from the children's short story, The Wump World. The story was chosen because of its simple text and story line, and abundance of illustrations that correlated directly with the text. The five presentation conditions were: (a) ORAL, an oral presentation on audio cassette of the story, (b) PICTURE, a 35-MM slide presentation of the illustrations used in the text of the short story, (c) CLOSE-UP, the same slides used in the picture condition with added close-up shots of the criterion information found in those slides, (d) ORAL+ PICTURE, a combination of the audio tape and the picture slides, and (e) ORAL+CLOSE-UP, a combination of the audio tape and the slide set with close-ups.

The presentations all lasted the same 15 minute time period to control for time on task. The PICTURE condition contained 47 slides; the CLOSE-UP condition contained the same 47 slides plus 28 close-up shots of criterion information selected from the 47 slides. Fourteen abstract and 14 concrete nouns were chosen as criterion information. The criterion nouns were chosen according to their abstractness-concreteness ratings on norms established by Paivio, Yuille, and Madigan (1968). The norms were later validated for children by Emmerich (1979). Each presentation condition was designed to contain all of the criterion information.

Criterion Measures

One dependent measure was performance on a 28-item, cued-recall, constructed-response test. The test was given orally by means of audio cassette tape. Single-word or short-phrase responses were written on an answer sheet. Fourteen items were abstract, and 14 items were concrete. The items were matched to the 28 nouns chosen as criterion information and contained in all five presentations. This test was administered immediately after the presentations and again after a two-week delay.

A second dependent measure was derived from an analysis of the answers that students gave on their tests. The score was derived by counting the number of items for which a subject had made the _same_ incorrect response on both the immediate and delayed tests. This score was a measure of mislearning, i.e., information that was not "correct," but was learned and remembered.

Procedures

The subjects were blocked on two levels of verbal ability

(HI or LOW) and then randomly assigned to the five presentation treatment conditions. The subjects were grouped according to treatment and the materials were group administered. Following the 15-minute presentation, subjects took a brief rest and then completed the test. The test was administered again two weeks later for a measure of delayed recall.

Design and Data Analyses

The study was a two (ability levels) by five (presentation formats) factorial design with two dependent measures (abstract recall and concrete recall). The data analyses were conducted by means of MANOVA.

Results

All effects in the study were the same for the immediate and delayed retention scores, and there were no significant differences between the immediate and delayed scores. Therefore, to simplify reporting, the mean of the immediate and delayed scores was used for the analyses in the study. The mean scores for abstract and concrete recall are summarized in Table 1.

Insert Table 1 about here

Presentational Stimuli and Types of Information

Analyses indicated a main effect for presentation for both abstract recall ($F(4,238)=20.21$, $p<.0001$) and concrete recall ($F(4,238)=23.49, p<.0001$). The rank order of means for both abstract and concrete recall was exactly the same: ORAL < PICTURE < CLOSE-UP < ORAL+PIC < ORAL+CLOSE. The patterns of significance for abstract and concrete recall were also the same. PICTURE and ORAL were not significantly different, but CLOSE-UP was superior to ORAL (abstract, $p<.05$; concrete, $p<.0007$). In this study, children learned and recalled at least as much from pictures as from an oral presentation, and when attention to the criterion information was focused via close-ups, children learned more from pictures. The combination of ORAL+PIC was significantly more effective than either ORAL or PICTURE or CLOSE-UP alone (abstract, $p's<.01,.01,.05$; concrete, $p's<.01,.01,.01$).

Analysis of the results for type of content indicated that for the nouns used in this study, subjects recalled more concrete than abstract information ($F(1,238)=83.60$, $p<.0001$). However, no interaction was found between the types of stimuli and the types of content; i.e., verbal and visual presentations were equally as effective for learning abstract or concrete information.

Ability Level

Subjects of high verbal ability learned significantly more abstract and concrete information than those of low ability ($F(1,238)=49.40$, $p<.0001$); however, an interaction was not found between ability levels and types of stimuli for either abstract or concrete learning.

Mislearning

Using mislearning as the dependent variable, there was a presentation main effect for abstract learning ($F(4,238)=3.97$, $p<.004$) and concrete learning ($F(4,238)=7.75$, $p<.0001$). The mean scores for abstract and concrete mislearning are summarized in Table 2. For ease of interpretation, the visual-only conditions

Insert Table 2 about here

(PICTURE and CLOSE-UP) were combined, and the two oral+visual conditions were combined (ORAL+PIC and ORAL+CLOSE). The amount of mislearning from the ORAL presentation was less than from the visual-only presentations (abstract, $p<.01$; concrete, $p<.01$), but there was more mislearning from ORAL than from the oral+visual presentations (abstract, $p<.001$; concrete, $p<.003$).

Discussion and Conclusions

Two limitations must be kept in mind when discussing the results of this study. First, the findings are specific to the particular story, presentational materials, and criterion information used in the study. Second, the equivalence of the oral and visual forms of the story was judged only at face value. Replication of this study is needed using different content and more scientifically equated stimulus forms.

The finding that children learned as much or more from visual as from oral presentations, is generally contrary to previous research. The finding validates the use of visuals for presentation of information and provides a perspective on the relative contributions of the verbal and visual portions of combined picture-word presentations. It was no suprise that the combined oral and visual presentations were most effective, lending one more piece of evidence to the argument for providing relevant visuals in children's prose. One noteworthy point not found in previous research is that the effects of visuals were the same for abstract and concrete learning. The practical conclusion is clear, that visuals are valuable regardless of the type of information that is being taught. A final point of practical significance is that visual close-ups seemed to help learners recall both concrete and abstract information. The explanation may be a repetition effect due to renewed learner attention caused by the slide projector changing. A more likely explanation may be that the close-ups allowed learners to isolate criterion information that they did not pick out of the full scene.

Better recall of concrete than abstract information was expected and cannot be generalized beyond this study, because no attempt was made to control for the influence of factors such as familiarity and meaningfulness.

The absence of any interaction between ability levels and presentations could be due to the careful design of the materials. Careful design could eliminate irrelevant or incongruous content that might affect low ability students more than high ability students. In view of contradictory findings from previous studies, further research would be valuable using other measures of ability.

The investigation of mislearning was exploratory in nature, and results are open to several interpretations. The low level of mislearning from the combined oral-visual presentations would be expected due to the redundancy between stimuli. An explanation of the higher mislearning for visual than for oral presentations might be that most pictures do not contain the cues of context and structure found in prose. It is thus possible that when learning from pictures, children are more likely to choose and remember unimportant details, or make and remember incorrect interpretations. This explanation fits the abstract results nicely, because one could logically expect that abstract information would be less obvious in pictures than in prose. By the same line of reasoning, however, one could expect that mislearning of concrete information would be higher from prose than from pictures, because concrete information should be more explicit in pictures. Results found by Hannafin and Carey (1981, Note 3) match this reasoning, but findings of the present study are exactly the opposite. The Hannafin and Carey study was conducted with fourth grade rather than third grade learners, perhaps indicating a developmental difference in the ability to use pictures. This aspect of mislearning certainly bears further investigation, as do the more general questions raised by the finding that response errors were not random, but were in part related systematically to the type of presentational stimulus used in instruction.

In conclusion, third grade students recalled more correct and incorrect information from pictures than from oral prose, but students recalled the most correct and the least incorrect information from combined picture with oral prose presentations. The study failed to confirm previous research about the interactions among types of stimuli, learner ability levels, and types of content. Finally, the study raised some new questions about the effects on testing of types of presentational stimuli and types of scoring techniques.

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Table 1

Mean Scores for Recall of Abstract and Concrete Information by Treatment

Presentation	Abstract Recall	Concrete Recall	Overall Recall
Oral (n=52)	4.62	5.87	5.24
Picture (n=49)	4.95	6.61	5.78
Close-Up (n=50)	5.42	7.19	6.31
Oral+Pic (n=51)	6.35	8.54	7.45
Oral+Close (n=45)	7.93	9.43	8.68
Overall (N=248)	5.80	7.45	6.63

(total possible correct = 14)

Table 2

Mean Number of Incorrect Responses on the Immediate Test that were Repeated on the Delayed Test

Presentation	Abstract	Concrete	Overall
Oral (n=52)	2.68	2.06	2.37
Visual (n=99)	3.09	2.65	2.87
Oral+Visual (n=96)	2.33	1.59	1.95
Overall (n=248)	2.71	2.11	2.41

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VISUAL TESTING: AN EXPERIMENTAL ASSESSMENT OF THE ENCODING SPECIFICITY HYPOTHESIS

HERMES T. DEMELO
ADJUNCT RESEARCH ASSOCIATE
201 CHAMBERS BUILDING
THE PENNSYLVANIA STATE UNIVERSITY
UNIVERSITY PARK, PENNSYLVANIA 16802
TEL. (814-865-0471)

MICHAEL SZABO
ASSOCIATE PROFESSOR OF EDUCATION AND
DIRECTOR OF THE INSTRUCTION SUPPORT CENTER
202 CHAMBERS BUILDING
THE PENNSYLVANIA STATE UNIVERSITY
UNIVERSITY PARK, PENNSYLVANIA 16802
TEL. (814-865-0471)

FRANCIS M. DWYER
SENIOR RESEARCH ASSOCIATE AND
PROFESSOR OF EDUCATION
114 MITCHELL BUILDING
THE PENNSYLVANIA STATE UNIVERSITY
UNIVERSITY PARK, PENNSYLVANIA 16802
TEL. (814-863-0668)

RESEARCH & THEORY DIVISION
ASSOCIATION FOR EDUCATIONAL COMMUNICATION & TECHNOLOGY
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ABSTRACT

PURPOSE

The purpose of this study was to empirically investigate the effectiveness of (1) visual instruction composed of simple line drawings and printed words as compared to printed-words-only instruction; (2) visual tests; and (3) the interaction between mode of instruction (visual and non-visual) and mode of testing (visual and non-visual).

METHODS & PROCEDURES

Ninety-six first-year biology students from a Central Pennsylvania high school system were the subjects of this study. After being randomly assigned to either an experimental (visual instruction) or control (non-visual instruction) group, they received either a visual or non-visual version of an instructional unit designed to teach the anatomy and physiology of the human heart.

Twenty-four hours later, half of the students (N=24) in the experimental group received a non-visual test and the other half (N=24) a visual version of the same test. This testing procedure was repeated for the control group following a 2x2 post-test-only factorial design. Drawing, terminology, identification, and comprehension tests was completed by all subjects in both experimental (N=48) and control (N=48) groups. Analyses of variance and a t-test were performed with the obtained data.

RESULTS

The findings of this study indicate that the visual version of the instructional unit on the human heart used in this study affected the performance of the students significantly in the drawing test and in each subscale (identification, terminology, and comprehension) as well as in the composite score of both visual and non-visual versions of the achievement tests.

The interaction between mode of instruction and mode of testing was revealed for the identification subscale. Subjects who completed the visual instruction scored higher on the visual test than the subjects who completed the same visual instruction scored on the paper-pencil version of the test on subscale identification. It was also found that the students who completed the visual instruction scored higher on the visual test than the students who completed the non-visual version of the test on the same subscale--identification. Finally, the students who completed the visual instruction scored higher on the visual test than the students who completed the non-visual instruction with the visual version of the achievement test on the identification subscale.

IMPLICATION

The findings and results of this study suggest that the use of simple line drawings as a mediator of written instruction is an effective procedure for enhancing student learning mainly when written words are not sufficient to communicate an abstraction; i.e., the description of the anatomy of the human heart as well as its physiology. Furthermore, visuals (simple line drawings) facilitate learning at different cognitive levels; i.e. identification of parts and whole, knowledge of

terminology, comprehension of relationship among parts, flaws, and the recall of shapes and positions. Visual tests are sensitive instruments for measuring specific instructional objectives (identification of whole and parts), the matching of visual instruction with appropriate visual test reflects a better performance of students when compared with the performance of equivalent students who complete the same instruction in an equivalent paper-pencil test. This latter observation was evident mainly for the criteria identification and marginally for the total criteria.

The results of this study suggest some guidelines for teaching.

1. Teachers should use visuals as mediator of instruction;

2. Teachers should use simple line drawings to enhance the learning of specific instructional objectives (identification, terminology, comprehension, and drawings);

3. Teachers should use visual tests to measure achievement which is presented by visual instruction.

VISUAL TESTING: AN EXPERIMENTAL ASSESSMENT OF THE ENCODING SPECIFICITY HYPOTHESIS

ABSTRACT

Although visual media for science instruction is nearly a university given, most evaluation strategies employ highly verbal rather than visual media. Ninety-six high school biology students studied the human heart using either visual plus verbal or verbal-only text. They were tested using either a visual plus verbal or verbal-only test incorporating several instructional objectives. Visual instruction resulted in superior learning on all objectives related to the biology content. The predicted instruction x test interaction revealed superior performance for the visual text-visual instruction group over all others for the objective of Identification. The visual and non-visual test groups attained equivalent understanding. The findings are interpreted as supportive of the encoding specificity hypothesis.

RATIONALE

The purpose of this study was to investigate the role of visuals in the processes of encoding and decoding textual instructional materials in science. A research hypothesis based upon the encoding/decoding component of information processing was tested with science content in a realistic classroom environment. This section reviews some issues and research on media, visual imagery, encoding, decoding, and the interaction between encoding/decoding.

Research on Media

Several reviews of media research, in general, have come to opposite conclusions regarding the effectiveness of visuals in instruction and testing. Dwyer (1978) concluded that much media research has severe conceptual and design flaws. The authors argue that focus on the form of stimuli without considering how the student processes information is partly responsible for the null results. One promising area is indicated by the finding that pictures of objects are more memorable than their names (Levie & Levie, 1975) for it points to an information-processing approach.

Visual Imagery

Research on visual imagery is an example of study involving the processing of information by the human brain. Gagné and White (1978) stated that several instructional procedures appear to have the purpose of using visuals to form mental images and that visual imagery is most pervasive and useful when compared with other types of imagery such as auditory, haptic, or a combination. Hilgard and Bower (1975) observed "It now seems reasonably certain that...teaching the pupil techniques of...imagery of materials to be learned are likely to maximize the amount of learning within the least time...." (p. 589)

Most imagery research has been limited to episodic memory as opposed to higher level cognition or semantic memory. Although there is scant research on the latter, Gagné and White cited evidence which supports the notion that supplementary imagery can enhance the recall of semantically-organized material as well as individual verbal items. Visual imagery was found useful in learning vocabulary and prose (Wittrock & Lumsdaine, 1977), in abstract and conceptual learning (Katz & Paivio, 1975), and in the understanding as well as recall of verbal materials (Higbee, 1979). Comprehension and ability to remember a passage was greatly improved when a descriptive title or a picture was given prior to the reading of the passage (Bransford & McCarrell, 1975). Research suggests that the formation of visual images can enhance verbal learning (e.g., learning from text).

Encoding

Encoding is generally defined as the process of successfully storing perceived information for later retrieval. This involves perception, processing through short-term memory and storage in long-term memory. Encoding of symbolic (textual) material was one focus of this study.

Most researchers accept the assumption that words are represented in memory in terms of their distinctive features, attributes or dimensions. It is further assumed that these features are qualitatively different and independent. Questions remain about how images provoked by external visuals are encoded relative to verbal representation.

Within the information-processing tradition, several theoretical explanations have been dominant in recent years, including advance organizers, mathemagenics, levels of processing, and context. Exhaustive reviewers are found elsewhere; this review examines visual imagery in light of these theoretical orientations.

Advance organizers. In theory, pictures may serve as advance organizers (Ausubel, 1968) if they provide organizational value at a higher level of inclusiveness and somehow capitalize on the mind's ability to semantically reorganize incoming information for long-term storage. Although most research has used verbal organizers, it may be hypothesized that the value of pictures will be maximized for material which is new, difficult, or abstract, as in the present study. Brody and Legenza (1980) found that subjects who viewed an overview picture outscored those who viewed a specific incident picture.

Mathemagenics. Mathemagenics, or things which give birth to learning, has been researched extensively by Rothkopf (1970) and others. The majority of mathemagenic research has used questions or behavioral objectives to influence learning from text rather than visual mathemagenics. Brody and Legenza (1980) substituted pictures for inserted questions and found results as predicted from mathemagenic research (placing pictures before the learning passage was more beneficial to achievement than post-pictures).

Levels of processing. The levels-of-processing model, proposed by Craik and Lockhart (1972) has spawned many variations. They all agree that the success of encoding information appears to be a function of the level of processing. Reder (1979) has noted that the more extra processing one does that results in additional, related, or redundant propositions, the better will be the memory for the material processed. The formation of an image, stimulated by visuals, is hypothesized to increase the processing over text alone.

One variation argues that memory traces are formed during learning and persistence of trace is a function of depth of processing, with deeper levels of analysis associated with more elaborate, longer lasting, and stronger traces. Elaboration theory posits that a greater degree of elaboration at input (encoding) leads to the formation of a more distinctive memory trace (Jacoby & Craik, 1979) which enhances the identification of that memory trace from competing traces.

Anderson and Bower (1973) argued that representation in memory is neutral with respect to modality source. In contrast, Paivio (1971) has proposed a levels-of-processing model which addresses visual as well as verbal encoding. This dual model posits that a learner has two independent ways of encoding and storing information--one is linguistic, and one is based upon images. He has argued that pictures are recalled better than labels because the former involves the dual encoding both as imaginal and as a verbal representation. Paivio's model clearly supports an extra processing dimension attributable to visual imagery formation.

Context. Bransford and Johnson (1973) argue that visuals enhance encoding by providing context for verbally presented (semantically encoded) information. They found Ss who were presented with a picture before hearing a passage recalled more ideas and rated the passage as more comprehensible than those presented with the picture after the passage. If correct, it appears that certain visuals enhance encoding by providing a "context" which is stored in semantic memory with verbal information. One implication is that study of visuals in information processing should consider the retrieval or decoding of information.

Decoding

The Ausubelian and mathemagenic theories place more emphasis on encoding than decoding processes. The model of Paivio argues that the retrieval of linguistically stored information may be aroused by visual images and vice versa. The mechanism by which this linking occurs is not well understood but is consistent with contextual storage notions. Research on testing using visuals has yielded consistently disappointing results. This research, however, has ignored any linkages between visuals used in instruction and those used in testing; it suggests the interdependence of the encoding and decoding processes.

Encoding/Decoding

A recent trend in information processing is the study of the interplay of the encoding and decoding processes. Eysenck (1979) cited considerable evidence that recognition memory can be impaired by changes from study to the test of the context in which an item is presented. It appears that material to be learned can be successfully encoded and still be unretrievable. Gagné and Wiegand (1970) used topical sentences at the time of testing and found better performance in a completion and recognition task. They concluded that in the absence of appropriate cues, not all that is available in memory store is retrieved. Dong and Kintsch (1968) found a similar phenomena when they provided subjects with retrieval cues at output and raised levels of recall for category word list and lists of unrelated words.

The encoding specificity hypothesis predicts that recognition memory depends upon the degree of overlap between the study trial and test trial encodings of any given item (Eysenck, 1979) It appears that the original context must be recreated at output if encoding distinctiveness is to be effective in allowing discriminability of the wanted trace from all others.

PROBLEM

Research on visuals, visual imagery and information processing suggests that if images are formed during encoding and elicited during decoding from visuals which are highly similar and fairly simple, the amount of information stored and retrieved will be considerably greater than when the visuals are not present. This led to the interaction hypothesis that the presence of visuals during testing would increase the amount learned for Ss who used visuals to encode images during instruction. Increased performance due to visual instruction (but none due to visual testing) was also predicted. Achievement at three levels of objectives was assessed.

METHOD

Subjects

Subjects were 96 volunteer tenth grade biology students from a Central Pennsylvania urban high school. The study took place during late winter, prior to instruction on the human heart. No credit for the experience toward course grade was given.

Materials

A 2,000 word self-paced instructional unit on internal parts and processes which occur during the systolic and diastolic phases of the human heart served as the content (Dwyer, 1978). In addition to permitting evaluation of several types of instructional objectives, the content had not been studied experientially by the Ss.

Illustrations were designed to portray each of 37 items of critical information. Samples of the text with and without visuals are presented in Figure 1.

Insert Figure 1 about here

Treatments

Subjects (n = 96) were randomly assigned to one of four treatment conditions: (1) text with visuals or (2) text minus visuals, and (3) test with visuals or (4) test without visuals. Instruction occurred during one regularly scheduled class meeting in one of five classes. Assignment was achieved by random distribution of color coded materials within intact classes. The tests were administered during the next regularly scheduled class (24 hours after instruction) to rule out short-term memory effects.

Instruments

Achievement was assessed through a 60-item multiple choice achievement test composed of three subscales: (1) Identification, 20 items, KR-20=0.74, (2) Terminology, 20 items, KR-20=0.62, and (3) Comprehension, 20 items, KR-20=0.54. The composite score had a reliability (KR-21) of 0.82. In previous research with college students, these instruments exhibited reliabilities in the .80's and .90's. The items of the criterion test were keyed to the domain of instruction represented in the instructional materials.

The visual version of this test has a visual item to match each verbal one. An equivalent visual distractor was created for each option. Figure 2 presents these formats for one test item.

Insert Figure 2 about here

In addition, a Drawing Test requires the subject to draw a human heart (lines) and locate certain parts and features of the heart on that drawing. This test was given to all Ss. The reliability of the Drawing Test, assessed by the KR-21 method, was 0.86.

Design and Analysis

The first independent variable had two levels: instruction with and without visuals. The second also had two levels: tests with and without visuals. These variables were crossed in a 2x2 randomized factorial posttest-only design. The dependent variables analyzed included scores on the Drawing Test plus Composite and three instructional objective scores of the achievement test. Two-way ANOVA statistical designs were run on each of the five scores yielded by the criterion tests and used the .05 level of significance to test the null hypothesis.

RESULTS

Interaction of Instruction and Testing

The prediction from the encoding specificity hypothesis that subjects receiving visuals in instruction *and* testing would score higher was supported for the Identification subscale. A significant interaction between instruction and testing, $F\ (1,92)=6.1$, $p<.05$ led to a follow-up analysis (Tukey) which revealed the superior performance of the visual instruction-visual testing group over each of the others. No other cell mean pairs were significantly different. The interactions were marginally significant ($p<.07$) for the Composite and Drawing scores, favoring the visual instruction-visual test group. Nonsignificant interactions were observed for the Terminology and Comprehension subscales. On these four subscales, however, the trends in mean scores clearly favored the subjects who had visuals in both instruction and testing. Cell means and standard deviations are listed in Table 1 for all treatment conditions and all objectives.

Insert Table 1 about here

Main Effect of Instruction

Subjects whose instruction included visuals scored higher than those without visuals on all five scores: Composite, $F\ (1,92)=12.5$, $p<.05$; Identification, $F\ (1,92)=11.1$, $p<.05$; Terminology, $F\ (1,92)=10.6$, $p<.05$; Comprehension, $F\ (1,92)=4.2$, $p<.05$; and Drawing, $t\ (60)=6.4$, $p<.05$. Cell and marginal means, plus standard deviations are found in Table 1. These results strongly support the role of visuals in the encoding stage of human learning.

Subjects with visual tests scored the same, within allowable error, as those with nonvisual tests. In only one case did the difference approach significance ($\underline{p} < .07$) and that was for the Identification subscale.

DISCUSSION

It is argued that the large number of criteria on which instructional effects were significant is indicative of a facilitative effect upon information-processing skills in the encoding process.

Similarly, the lack of main effects for testing questions the power of visuals used only the decoding process.

The data, although not overwhelming, support the facilitative effects of using the same visuals during instruction and testing. Partial support can be ascribed to the encoding specificity hypothesis (Eysenck, 1979) and context continguity notion of Bransford and Johnson (1972).

An Ausubelian explanation does not appear warranted since the visuals did not attempt to present an overview at a higher level of inclusion and generality. Because the visuals were placed within the instruction, a mathemagenic explanation lacks plausability. Neither the Ausubelian nor the mathemagenic positions pose a substantive explanation of decoding process on how they interact with encoding processes. Facilitative organization to enhance learning by non-Ausubelian and non-mathemagenic mechanisms cannot, however, be ruled out.

Implications for Instruction and Evaluation

The results suggest that a barrier to successful decoding of stored information may be removed by using visuals to recreate key elements of the context in which instruction was provided. In other words, it is recommended that the science teacher provide highly similar visual cues during instruction and evaluation, particularly if the instruction is highly visually-oriented.

Implications for Research

Significant interactions occurred only for the lowest level of instructional objective tested (Identification). If visual information must be coded verbally (Travers & Alvarado, 1970) it is hypothesized that this translation process loses its effectiveness as the complexity of cognitive processes tapped increases.

An implication can be made for further study of individual differences in information processing ability and their relationship to acquisition of understanding. It is interesting to speculate whether differential results would be obtained with learners of different aptitudes. It can be hypothesized that students with reduced ability to recreate instructional environments will perform better under visual context conditions. Interactions of visual placement with inductive reasoning ability were noted by Koran and Koran (1980).

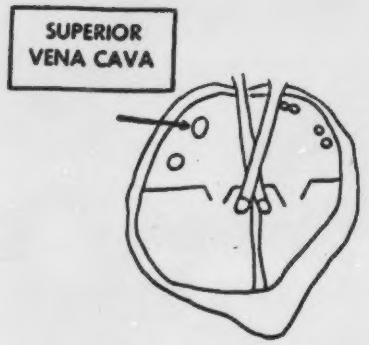
Holliday, et al. (1970) have argued from a zero-sum standpoint that displaying of visuals in text may result in more attention paid to one cue and less to another, resulting in reduced effectiveness of visuals. These notions bear further investigation.

If memory for visuals is greater than memory for text, the duration of that memory differential should be quantified with delayed retention tests.

Recent research suggests that training students to create mental images during instruction results in superior achievement (Rasco, Tennyson, & Boutwell, 1975). A legitimate question to be investigated is the relative effectiveness of induced imagery versus that generated by visuals provided in instruction as a function of individual learner differences. A corrollary question addresses the effectiveness of asking students to generate images for which there is no personal knowledge or experience. Certainly the number of students with firsthand experience with the human heart is insignificant.

The results of this experiment have suggested a new direction for visuals in instruction and additional ideas for further reasoned study.

10/80



As you would view a cross-sectional diagram of the heart, blood enters the right auricle through veins. Only veins carry blood to the heart. The superior vena cava is one of the two veins which deposits blood in the right auricle. There are no valves at the openings of these veins into the right auricle. The superior vena cava drains blood into the right auricle from all body parts above heart level; i.e., head and arms.

SUPERIOR
VENA CAVA

As you would view a cross-sectional diagram of the heart, blood enters the right auricle through veins. Only veins carry blood to the heart. The superior vena cava is one of the two veins which deposits blood in the right auricle. There are no valves at the openings of these veins into the right auricle. The superior vena cava drains blood into the right auricle from all body parts above heart level; i.e., head and arms.

Figure 1. Page 8 from the visual instructional text (top) and Page 8 from the nonvisual instructional text (bottom).

42. When blood is being forced out the right ventricle, in what position is the tricuspid valve?

- a. partially opened
- b. partially closed
- c. open
- d. closed

42. The position of the tricuspid valve when blood is forced out of the right ventricle

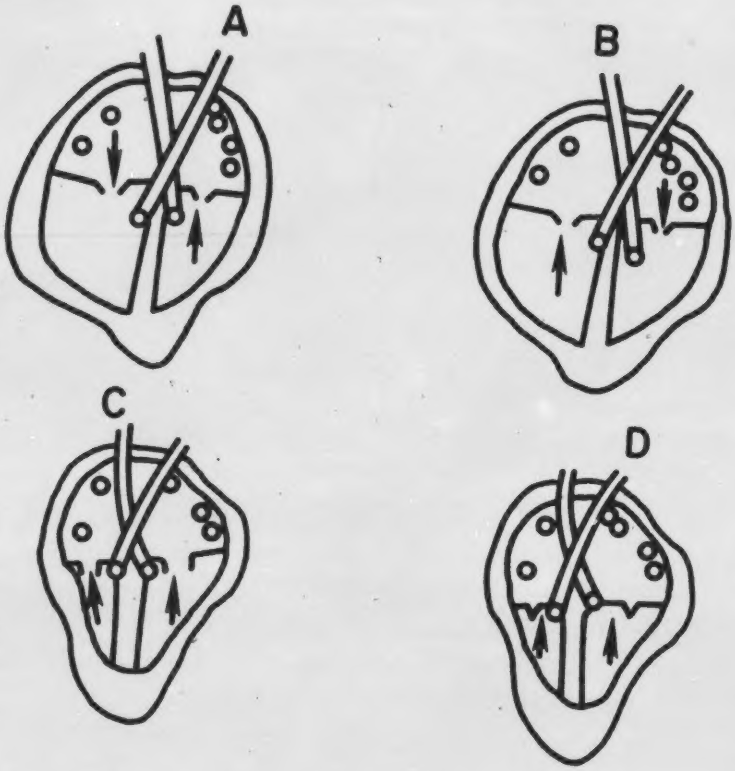


Figure 2. Item 42 from the verbal test (top) and visual test (bottom).

Table 1
Mean Scores and Standard Deviations for Cells, Rows, and Columns for Composite and Three Subscores

Instructional Conditions	Testing Conditions		
	Nonvisual	Visual	Rows
Composite Score			
Nonvisual (n=48)	19.3 (7.2)	18.2 (6.9)	18.8 (7.1)
Visual (n=48)	22.1 (9.0)	27.0 (8.5)	24.5 (8.8)
Column Sums	20.7 (8.1)	22.6 (7.7)	21.6 (7.9)
Identification Subscore			
Nonvisual	6.6 (3.1)	6.1 (3.1)	6.4 (3.1)
Visual	7.3 (4.3)	10.5 (4.2)	8.9 (4.2)
Column Sums	6.9 (3.7)	8.3 (3.7)	7.6 (3.7)
Terminology Subscore			
Nonvisual	6.2 (3.2)	6.0 (2.7)	6.1 (3.0)
Visual	7.3 (3.2)	9.0 (3.2)	8.2 (3.2)
Column Sums	6.8 (3.2)	7.5 (3.0)	7.1 (3.1)
Comprehension Subscore			
Nonvisual	6.5 (2.8)	6.0 (2.7)	6.3 (2.8)
Visual	7.5 (3.3)	7.4 (2.6)	7.5 (3.0)
Column Sums	7.0 (3.1)	6.7 (2.7)	6.9 (2.9)

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TITLE: Analyzing Functions of Illustrations in Text

AUTHOR: Philippe Duchastel

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ANALYZING FUNCTIONS OF ILLUSTRATIONS IN TEXT

Philippe Duchastel
The American College, Bryn Mawr.

Whether illustrations in textbooks enhance learning is a question of some concern to educators and publishers alike. And of course, educational researchers have applied themselves to investigating this issue. Research on illustrations in text has however had a very muddled history. The literature covering this area is replete with research studies which have failed in their attempt to show that the provision of illustrations can enhance learning. There exist, on the other hand, many studies which have been successful in showing such facilitation. Research by Joel Levin and his associates at the University of Wisconsin has been particularly successful in this respect (Levin and Lesgold, 1978). Their research however is mostly limited to pictures which accompany children's stories presented orally. Pictures included in textbooks present a somewhat different problem.

We must ask ourselves why it is that research on illustrations in text has proven so inconsistent? Why is it that researchers have had such a difficult time in demonstrating empirically that pictures can enhance text learning? Part of the reason must surely be methodological difficulties concerning the particular pictures used in some studies, as Macdonald-Ross has aptly argued (1977). Part of the reason probably also stems from some of the inherent difficulties one encounters in conducting educational research, such as incomplete control over the strategies actually used by students as they study a text. The greatest problem however has probably been the lack of a useful conceptual framework within which illustrations and their effects could be properly examined. It is this latter concern which I will be exploring in this presentation.

The underlying aim of a great part of past research on illustrations has been quite simply to demonstrate empirically that illustrations can enhance learning. This in my view is a misguided aim, for two distinct reasons. First, it should be accepted as obvious that illustrations can affect learning, in an a priori fashion so to speak. It is only necessary to examine a few textbooks in science or medicine to come to accept this view. Whether our impressive research methods arrive or not at demonstrating pictorial effects should be of little concern to those who illustrate textbooks.

Now, while the case can be accepted that some illustrations will undoubtedly enhance learning, that is not to say that all, or even that most illustrations will do so. This brings me to the second reason for which the general demonstration of pictorial effects on learning really amounts to little.

Pictorial illustration is a medium of communication, just as is textual prose, film, or CAI. While each of these media have their distinctive characteristics, their forms of expression are varied and numerous. It is not so much the medium itself which is important, but rather the contents being represented and the manner of representation. A diagram in an economics text for instance is rather different than a cartoon fronting a chapter, even if both can be called illustrations. Thus, some illustrations will enhance learning while others may well not. At a general level, nothing much can be said.

Analytical Perspectives

All this points to the need for a useful conceptual framework within which illustrations can be analyzed. Two distinct approaches exist to this problem. The first is an attempt to analyze illustrations in terms of their morphology, i.e., in terms of what they look like. The second is an attempt to analyze illustrations from a functional viewpoint, i.e., in terms of the roles they are expected to play in a text. I will discuss both approaches, although I am myself partial to the second one (the functional approach).

Morphological Analysis.

Morphological analysis is exemplified by the schema developed by Twyman in England (1979) for the purpose of classifying forms of communication. Its intent is to elaborate dimensions on which communications differ in appearance. A previous approach along this same line was the taxonomy of illustrations developed by Fleming in the 1960s (Fleming, 1967). It categorized illustrations according to colour, design, and a number of other such attributes. Further more recent approaches are those of Ashwin (1979) who focuses on style, and of Goldsmith (1980) who develops a grammar of pictorial representation based on the comprehensibility of pictures. Both, incidentally, have appeared in the new British journal entitled Information Design Journal.

Morphological frameworks can serve as useful guidelines for instructional illustrators in deciding on forms of representation. They can also be useful to educational researchers in coming to grips with the great variety one finds in the world of illustrations. This is demonstrated in the well-known research undertaken by Dwyer (1978) on the value of different levels of realism in biological illustrations.

On the whole though, I do not believe that the morphological approach will prove very fruitful in the long run. There is just too great a variety in illustrations for them to be categorized adequately in terms of differential effects on learning. The problem becomes truly insuperable when subject matter content is considered. Realistic illustrations for instance may not be ideal (for certain learning outcomes) in introductory biology, but they may well be ideal in architecture or engineering. The scope for creativity in text illustration is just too wide for a morphological approach to truly inform educational research and practice.

Functional Analysis. I shall now turn to the second approach to developing a conceptual framework for the field, a functional approach. This approach is based on the view that what an illustration looks like is less important (within limits) than what it is meant to do in a given text. It is the role of illustrations which matters most, not their particular form. An initial indication of this is provided once again by the work of Dwyer (1978), who found that different forms of illustrations were best for different outcomes.

Two different categorizations of the functions played by illustrations in text have recently been developed independently of one another, the first by myself the second by Joel Levin of the University of Wisconsin.

Let me briefly describe these categorizations. My own (Duchastel, 1978) involves three functions, i.e., three roles which text illustrations can play in an instructional situation: (1) an attentional role, (2) an explicative role, and (3) a retentional role. I shall only briefly describe them here.

The *attentional* role of illustrations in text is one of maintaining the learner's attention to the task of reading. It renders this task more pleasurable and develops the student's interest in the topics being discussed. Pictures naturally attract attention; and cartoons, pictures of famous men, etc., are often included in texts for this very reason. *Explicative* illustrations, on the other hand, carry more directly part of the communication. Their role is to explain in visual terms what would be cumbersome to explain in purely verbal terms. Scientific diagrams are prototypical of this role. The *retentional* role of illustrations is more difficult to summarize. Essentially, it rests on our greater power to recall images as opposed to verbal ideas, as well as on the fact that any topic or domain of discourse has an internal structure which can be exploited in visual terms for the purpose of recall. Retentional illustrations serve as memory retrieval cues after a text has been read and the student is trying to recall the major ideas which had been presented in the text.

I shall now turn to the functional system developed by Levin (more amply defined of course in Levin's original article, 1979). Levin identifies eight possible functions which illustrations might play when accompanying prose. The first two (*decoration* and *remuneration*) are quickly listed and dismissed by Levin as not applicable to understanding pictorial effects in instruction. The remaining six are more relevant.

The *motivation* function is identical to the attentional function we saw earlier. The *reiteration* function involves simple repetition of the content being communicated; once verbally in the text, once pictorially in the illustration. This is not unlike reading an unillustrated text twice.

The fifth and sixth functions are more psychological in nature. The representation function renders the prose content more concrete through illustrations and thus more memorable. The organization function of illustrations assists integration of information somewhat as an overview would.

The last two functions act on comprehension and memory respectively. The interpretation function is served when difficult-to-comprehend prose content is made more understandable via an illustration. It may also be served when illustrations provide context for understanding unfamiliar material, in the manner of activating a schema. The transformation function is operative when pictures serve as mnemonic devices, transforming the prose material into an image of more memorability than the original prose itself.

Well, we seem to be developing quite a few functions which can be served by illustrations. To make matters worse, a colleague and myself (Duchastel and Waller, 1979) have attempted to break down my original explicative function into subfunctions. We asked ourselves how explicative illustrations actually do make content easier to comprehend. We ended up with seven relatively distinct subfunctions, and that was even incomplete as I have since added yet another one to this list.

Too many functions, or too many fine distinctions between them, however eventually defeat the purpose of developing a useful conceptual framework for examining illustrations in text. Some process of consolidation needs to be brought to bear on the problem. This is what I shall now attempt to do.

Reviewing Functions

I start by dismissing three of the functions identified by Levin: the decoration function, the remuneration function, and the reiteration function. The first two of these may be important to the publisher, but they are of no use to the educator or to the learning theorist. Levin himself dismisses both of them likewise, after initially including them for the sake of comprehensiveness. The reiteration function simply embodies the idea that repetition is helpful, but that does not explain much. Illustrations generally do repeat the content of a text, but they also do more than just that; otherwise, mere verbal repetition would do just as well (and it does not). Levin is also aware of this and indicates that he finds reiteration uninteresting as an explanation for pictorial effects.

We thus start afresh with five of Levin's functions. It is interesting to see how they map onto or mesh with the three functions I had arrived at myself. (cf. Figure 1).

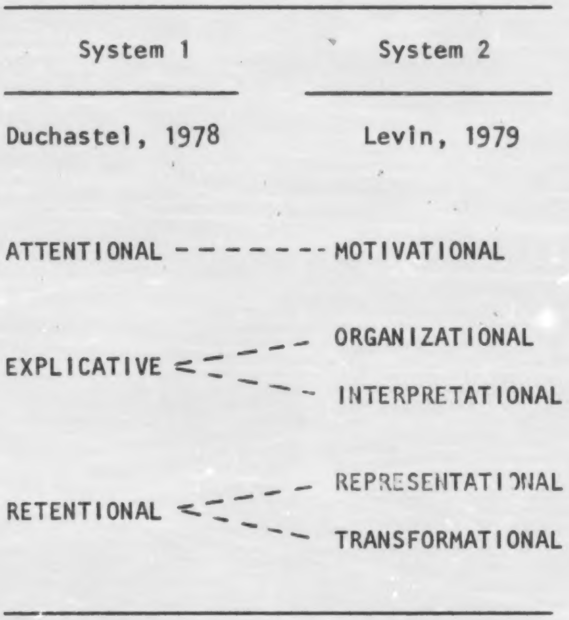
System 1
System 2
Duchastel, 1978
Levin, 1979
ATTENTIONAL
MOTIVATIONAL
ORGANIZATIONAL
EXPLICATIVE
INTERPRETATIONAL
REPRESENTATIONAL
RETENTIONAL
TRANSFORMATIONAL

Figure 1: FUNCTIONS OF ILLUSTRATIONS IN TEXT

This is how I see it. The motivational function is of course identical to the attentional one - they are simply different labels for the same process of increasing the reader's interest in the text.

I next categorize Levin's organizational and interpretational functions as two facets of a more general explicative function. By organization, Levin refers to the ability of some pictures to help structure the content being presented, to help integrate elements of the text presentation which may not be apprehended as a whole by the reader. By interpretation, he refers to the ability of pictures to clarify complex content, as say a diagram might do. Both of these functions are aimed at enhancing comprehension on the part of the learner, i.e., they serve an explicative role. Indeed, Levin discusses these two functions in relation to poorly structured or difficult-to-comprehend text information. With easy text, pictures will add little to comprehension. Most subjects however are not easy, and the explicative role of illustrations is probably the most pervasive and well-recognized one in text publishing, perhaps because of its heavy emphasis in science texts.

Finally, I consider both of Levin's remaining functions as related to retention, as opposed to comprehension. The representational function is aimed at making the content more specific, more concrete, or richer. Representational pictures recast the content in a second modality and lay down a more easily retrievable memory trace. They reiterate the content but also make it vivid and memorable. The transformational function is aimed very directly at retention. It involves transforming the content into a new form which is easier to remember than in its initial form. Its verbal analogue is the mnemonic.

This then is how I see the relations between the two systems for representing the functions of pictures in text. Levin's categories involve finer discriminations, but map out well onto the more general 3-function system on the left of the figure. Even finer discriminations are possible, as I mentioned earlier with respect to the analysis my colleague Waller and myself performed with respect to the explicative function. Such an analysis becomes rather academic however if one goes too far along this line. We must ask ourselves why considering functions is important; when is it useful?

Levin developed his categorization of functions as an explanatory device to account for the results of research on pictures in prose. He was specifically interested in explaining the differential results obtained with visual illustrations and with visual imagery instructions. He was particularly concerned in this respect with the distinction between the representational and the transformational functions (both retentional functions according to my earlier analysis).

My own interest in functions of pictures in text, on the other hand, was motivated by a concern that the general question of pictorial effectiveness (i.e., Do pictures facilitate learning?) is meaningless. I simply wanted to refine the question, both as a grounding for research and in order to inform text design.

The practical use of functions in designing texts remains the true test of either system's usefulness. Not much has been done yet in the realm of application. The functional approach to text illustration, as an explicit conceptualization, is still very new. Whether it will catch on so to speak, both in research and in design, remains to be seen. I myself, as you will have gathered, am convinced of its potential usefulness.

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COLLEGE PROGRAM EVALUATION AND ID

Presented by
Cass Gentry

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COLLEGE PROGRAM EVALUATION AND ID

by

Cass Gentry

A continued lament among instructional developers concerns their general inability to demonstrate the effects of instructional development services toward improving college programs. Today, as in the past, instructional development (ID) remains a luxury that is subject to the visisitudes of political & budgetary winds. During hard times, ID services may be reduced, or even eliminated, without demonstrable ill effects to the colleges they serve. Instructional developers certainly believe their efforts make significant differences in the effectiveness of programs, but the indicators used for decision making (by those in control of college programs), seldom demonstrate that difference. Thus, instructional developers spend much of their time seeking the favor of administrative princes and princesses by becoming valuable in ways not necessarily related to ID. An uncertain existence at best.

There is no evidence that program development & evaluation conditions, described by Dressal (p. 176) in 1970, have changed for the better:

> "Most courses and new curricula are added without sufficient information and evaluation. Frequently the information provided obscures the relation of the course to existing courses or is so vague that the instructor can do anything he wants. Objectives are rarely defined, no selection of content and materials are made, and no text or bibliography is provided. Departments and colleges demand approval of additional courses and curricula as an act of faith, and unfortunately, usually succeed. College and university curriculum committees, if they exist at all, tend to give only cursory attention to new proposals, and almost never engage in review of existing programs"

Part of the reason that instructional development services are in such a tenuous position, is their inability to obtain relevant data for making instructional development decisions, and to demonstrate the effects of those decisions. The thesis of this paper is that until such time as reliable data from program evaluation can convincingly demonstrate the relationship between program success and the efforts of ID services, the profession will continue in this tenuous position.

In his book, Human Competence, Gilbert quotes a teacher (p. 358) who contends, "You can't do well, if you don't know how well you're doing." A worthy paraphrase might be, "You can't do well, if decision makers don't know how well you're doing." Regretfully, only a partial solution is offered here, but this partial solution may provide a much needed base of both form & substance, from which the next step may be taken.

Orientation to the Problem

There are numerous program evaluation models in the literature that are conceptually well designed, but none have seen effective implementation across the programs of a typical college. Figure 1 presents, in an abbreviated fashion, a process for program evaluation and revision. While the processes and the decisions listed offer few surprises to instructional developers, the assumptions supporting such models, and their implications for operational processes and decisions are confusing. Consideration of the steps in Figure 1, should provide a useful orientation for the proposed solution that follows. The steps below are keyed to the processes and decisions in Figure 1.

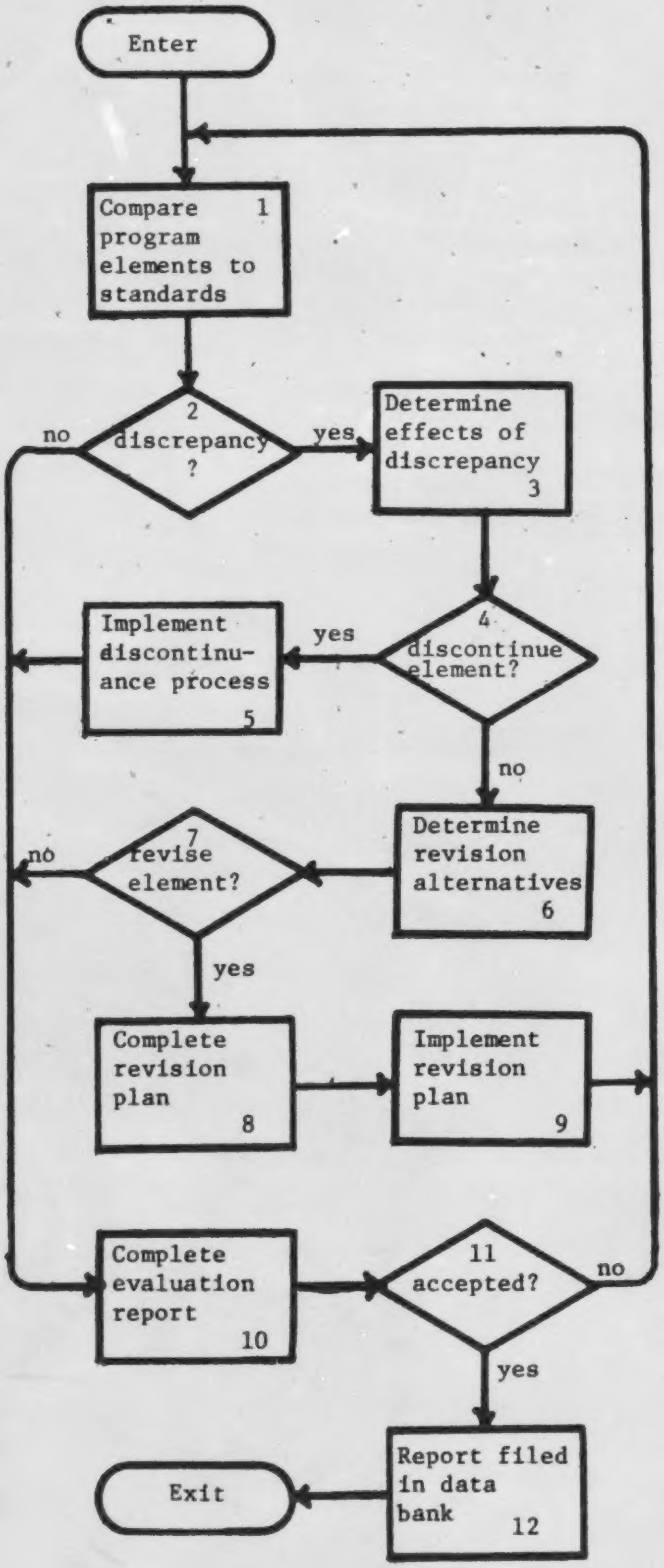
Step 1: "Compare Program Elements to Standards"

This process assumes a number of things, including: 1) that program faculty and administrators actually desire such a comparision, 2) that they have agreed to a particular program evaluation model, 3) that there is also agreement on a common set of standards for the program, and 4) that valid & reliable program data is available for making the comparison.

Step 2: "Are There Any Discrepancies?"

The purpose of matching the program elements against a set of standards, is obviously to determine if the elements meet the standards. A discrepancy exists when elements do not meet agreed upon standards. Serious disagreements often surface at this point. One person's discrepancy, might very well be what another views as an essential element. Despite previous faculty agreements about abstract standards,

Figure 1: GENERAL PROCESS FOR CONTINUOUS PROGRAM EVALUATION AND REVISION


Enter
Compare program elements to standards 1
2 discrepancy ?
no
yes
Determine effects of discrepancy 3
4 discontinue element?
yes
Implement discontinuance process 5
no
Determine revision alternatives 6
7 revise element?
no
yes
Complete revision plan 8
Implement revision plan 9
Complete evaluation report 10
11 accepted?
no
yes
Report filed in data bank 12
Exit

This simplistic visualization targets what needs to be done, but not how to do it. Below are examples of operational questions implied by the process. The number of the question is keyed to the relevant activity or decision point in the flowchart.

1. Means for comparing the program elements to predetermined program standards?
2. Means for discriminating between a discrepancy and a non-discrepancy?
3. Means for determining the programmatic effects of an identified discrepancy?
4. Means for determining criteria used for deciding to continue or discontinue a program or some of its elements?
5. Means for actually discontinuing a program or program element?
6. Means for determining revision alternatives?
7. Means for determining the feasibility of revision alternatives?
8. Means for determining criteria for choosing among revision alternatives?
9. Means for carrying out a revision of a program or of a program element?
10. Means for determining what should be included in an evaluation report?
11. Means for determining criteria for accepting or rejecting an evaluation report?
12. Means for processing, storing and retrieving evaluation report data?

when specifics are identified, program evaluators often find that standards are not worth the blood they were written in.

Step 3: "Determine How The Discrepancies May Affect the Program" This process is designed to estimate the effects of a discrepancy on programs or program elements. While some effects are easily determined, others are not and may require more data about the program than is available. This ambiguity lends itself to considerable debate among affected parties.

Step 4: "Should the Program or Program Element be Discontinued?" Some discrepancies can be expected to have a more severe effect on a program than will others. In some cases, a program element can be discontinued without serious consequences to a program, or the program may in fact be improved with the deletion of an element. In other instances, an element may be viewed as essential to a program, but require some modification in order to meet the standard.

Step 5" "Implement Discontinuance Process" Many programs and courses simply fade away, or are gradually replaced by others as their resources are co-opted. The lack of a well-defined process for discontinuing programs represents a problem to colleges, in that resources that could be used for program development may be tied up, long after a program or some of its elements pass the point of usefulness.

Step 6: "Determine Alternative Ways of Revising a Defective Element" This process assumes that the defective program element can be repaired, and examines different means for that repair. The process determines the resource expenditures for the alternative means studied, including time and dollar cost. According to Newman, (from Bass and Lumsden, p. 173):

> "The lack of valid economic evaluations of the effectiveness of instructional development can be blamed on a number of factors. Questions of instructional cost-effectiveness are considered to be somewhat illegitimate by academicians. Administrators are under too great a pressure to produce immediate improvements to be concerned with the long-range evaluation necessary to demonstrate cost-effectiveness."

Step 7: "Given Available Alternatives, Should the Element be Revised?" At this point, the decision to modify or not to modify is re-examined. If the costs of the alternatives available are too great, and if the continued operation of the defective element is more practical than carrying out the revision, then administrators and faculty may decide to continue operating the element without revision.

Step 8: "Complete the Revision Plan" This process involves tying the favored revision alternative to the resources and individuals who will be responsible for carrying out the revision.

Step 9: "Implementation of the Revision Plan" Implementation is concerned with making all parts of the revision plan operational. It assumes access to the necessary expertise for accomplishing the change, and skills for demonstrating that the modification works as designed.

Step 10: "Complete an Evaluation Report on Actions Taken" This process assumes that college program decision makers require information about the actions taken in the above processes in order to make final decisions about the element and standard in question.

Step 11: "File Report in the Program Data Bank" The information regarding actions taken would be stored for future reference. This step assumes the need for future reference, and a system for storing and retrieving such information.

The view presented here is that if instructional developers wait until complete program evaluation systems are installed, they may wait forever. The question becomes, then, is it possible to install an approximation of a college program evaluation system that can provide data of a quality that will be accepted as evidence of the value of what instructional developers do?

The next several pages present an outline of the logic leading up to the implementation of the partial solution mentioned earlier. The solution is not without its problems, some of which are probably not clear to the writer. If it is workable, it will only be as a result of considerable additional planning, and a great expenditure of energy on the part of instructional developers. But, if it works, it could demonstrate, in a hard evidential manner, whether the actions of instructional developers make a significant difference, or not. As a point of departure, this presentation makes no attempt to look at the broad range of purposes that program evaluation might call for. Sara Steele (p. 39) illustrates how evaluation should vary with purpose, through the following analogy:

> "The situation can be likened to examining a mountain. The geographer is interested in topography. The geologist in rock samples. The mountain climber, the engineer designing a railroad, the pilot flying over the mountains, and the native going from one valley to another are all getting data about a mountain range to try and describe, evaluate and deal with it. But the data gotten and the approach to getting that information are far from the same."

Neither does this presentation seek to put in perspective the many different meanings of evaluation found in the literature, but rather looks at evaluation simply as a means "...to provide information for decision making." (Cook, p. 23). Further, this presentation does not begin to deal with all of the processes and data required to carry out ID services at the level possible under ideal conditions. Instead, it looks at a few essential data and processes that are believed will provide a sufficient level of evidence for more objective decision making about the effects of ID on program development. The outline below, attempts to illustrate the process of thinking through this problem.

Outline of a Partial Solution

1. ID is not usually considered an integral part of college program decision making
    a. The value of ID is not clear to college decision-makers
    b. When hard times come, ID may be reduced or eliminated
    c. Educational decision makers decide what needs to be done, for reasons that include, 1) external pressure, 2) because some of them are interested and

have the power to make change, and 3) because it is a means of acquiring outside funding. Most of these decisions are made on the basis of less than valid or reliable data.

   d. How, then, is ID made valuable to college programs?
   e. Stronger yet, how is ID made indispensable to college programs?

2. What is it that IDers do that should be considered indispensable to college program development?
   a. They are skilled in the processes and techniques of analyzing instructional problems and determining and implementing appropriate technological solutions.
   b. The trouble is that decision makers expect that others (teachers, administrators, etc.) can do the same job that IDers do.
   e. IDers may be able to provide fancy twists to the process, but decision makers have no real evidence that what IDers do is of a greater order of magnitude than what smart, able teachers are able to do. IDers have had limited success at disproving this assumption.
3. How do we get evidence that what we do is significant in improving learning?
   a. As a rule, educators collect little or no hard data that demonstrates how well their instructional delivery systems perform.
   b. Program and course development decisions are based on subjective judgements
   c. The use of subjective judgement, rather than hard information to make decisions has not resulted in favorable outcomes for ID during hard times.
   d. The assumption is made that decision makers would come to different conclusions about ID if they were in possession of hard data on how ID effects instructional delivery systems.
4. What are the kinds of hard data that could empirically demonstrate the value of ID?
   a. One way is by showing the impact of ID on the products of educational systems
   b. Student learning is a major product of educational systems, although certainly not the only one. Generation of new knowledge through research, service to the community, and employment of educators are others.

c. IDers need hard data that will show:

  1) that the things that they do significantly improve instructional courses and programs.

  2) that individuals without similar preparation cannot do as well, by a significant order of magnitude.

5. How can IDers help make it possible for decision makers to acquire the kind of valid, reliable data that will demonstrate the value of IDers in the process of instructional development?

  a. The first assumption is that a college is a purposeful system.

  b. All systems have definable functions that are their reasons for existing.

  c. A major function of educational systems is to deliver specific relevant instruction, effectively and efficiently.

  d. College wide functions are usually stated as missions, college program functions are usually stated as goals or general objectives and the functions of courses in college programs are usually stated as performance objectives (at some level).

  e. Logic directs that such functions should guide the behavior of decision makers. However, these functions and their relationships are often poorly or incompletely defined, or not stated at all. IDers can be helpful through their skills for analyzing and clarifying missions, goals, and objectives.

  f. A second problem that decision makers face (poorly) is the processing of information related to college program functions. They find manual processing of this mass of information close to impossible, and when attempted, the information is seldom timely or in the appropriate form for efficient and effective use. IDers have the skills of applying such models.

g. A third problem decision makers have is in applying practical evaluation models to their instructional programs. IDers have the skills of applying such models.

h. A fourth problem that decision makers have is gaining acceptance of change by educational personnel. IDers are trained in diffusion of innovation techniques.

6. How can IDers assist decision makers in clarifying and showing the relationships among missions, goals and objectives?

   *a. The college missions, program goals, and course objectives of most colleges are not easily collected, particularly course objectives.

   b. When accumulated they are often found to be disheartenly ambiguous, lacking the necessary precision needed for objective decision making.

   c. IDers may have to apply the principle of successive approximations to this task.

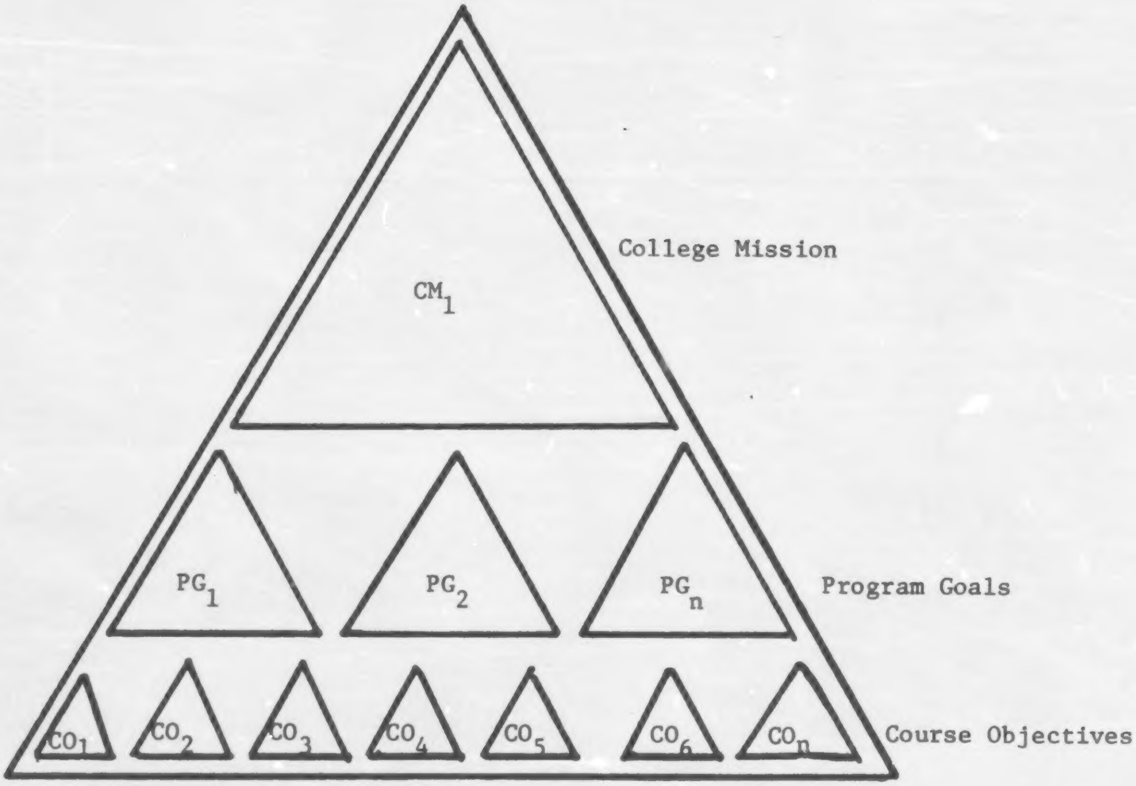
      1) IDers will have to search out as many of the missions, program goals, and course objectives as they can find. It is assumed that it will be possible to collect all of the college mission and program goal statements initially, but not necessarily all of the course objectives (need to consider what a critical mass might be).

      2) Although some decision makers might be willing to provide resources for generating more precise statements, IDers may have to contribute their own resources and personnel for initially increasing the precision of college missions, goals, and objectives. This is a serious undertaking. The precision of most of the objectives, initially, will probably be at the level that Eisner (p. 16) calls, "expressive objectives." An example of an expressive objective that he gives is "to interpret the meaning of paradise lost." IDers have skills for making such objectives more precise.

3) Missions, goals and objectives will have to be restated so that the relationships among them can be demonstrated.

   a) IDers would develop a series of hierarchies of mission, goal and course objective statements, as in Figure 2.

   b) A separate hierarchy for each mission would need to be developed (decision makers would probably profit by being able to relate the missions as well, but for the moment it does not seem to have direct bearing on IDers' needs).


College Mission
CM_1
PG_1
PG_2
PG_n
Program Goals
CO_1
CO_2
CO_3
CO_4
CO_5
CO_6
CO_n
Course Objectives

c) In all likelihood after the hierarchies are formed, IDers will find that they have some missions without sufficient program goals. Likewise, there may be insufficient course objectives for the goals of the program. In turn, there may be program goals for which there are no college missions, and there may be course objectives for which there are no program goals.

d) Administrators will need to make decisions about such discrepancies. In some cases they may choose to cut missions, goals and/or objectives out of the college curriculum entirely. In those cases where missing program goals or course objectives are viewed as necessary, their development could obviously involve IDers.

4) Several arrays of the missions, goals, and objectives will be necessary in order to show important relationships among them.

a) One of the arrays would be the hierarchial array described above, permitting identification of missing and inappropriate missions, goals, or objectives.

b) An array is needed to highlight overlap and duplications among programs and courses as they presently exist, and to prevent unnecessary duplication as the result of future changes in the curriculum (Dressal, p. 171).

c) For this purpose an ERIC-like thesaurus could be developed consisting of descriptors under which college missions, program goals and course objectives could be categorized. Examples of such categories might be "graphic production", "ID consultation", "instructional strategy discrimination", "change technique", or "classroom discipline".

d) A relatively simple computer program could store and retrieve these objectives according to the descriptors.

e) As new courses are requested, their objectives would be categorized under these descriptors and the computer could be queried to array all existing course objectives relevant to that descriptor.

f) Objectives appearing to duplicate others could be checked out, since the objectives could also be arrayed by course number.

g) Inspection of the array of goals or objectives could assist in answering sequence questions (i.e., which objectives should preceed others).

h) Viewing these objectives as a sequence would permit curriculum specialists to determine gaps among the objectives or goals.

i) Such sequencing could lend itself to a PERT array, which would assist in costing out a particular instructional sequence.

j) Which in turn could lead to a cost-benefit analysis of an instructional sequence, or for comparing alternative instructional sequences.

k) Such a capability could be one source of hard data that could help demonstrate the worth of IDers' efforts.

7. How can IDers assist college administrators to acquire and apply hard data in the evaluation of a college curriculum? The value of answering this question assumes that the existence of such hard data would help provide the base necessary to demonstrate the effects of IDers when they involve themselves in revising deficient instructional delivery systems.

   a. Part of that assessment has already been discussed with the proposed capability of discriminating gaps or duplications among missions, goals, and/or objectives.

   b. The major types of evaluation data needed by administrators and faculty is about the effectiveness, efficiency, and relevancy of the elements making up the college curriculum.

   1) Effectiveness measures seek to determine if actual student learning matches the intent of the instructional delivery system design.
   2) Efficiency raises the cost/benefit question. Are programs getting the most "bang" for their buck?
   3) The relevancy question asks whether the outcomes of specific instructional delivery systems is needed by students or society?

c. The efficiency question is best answered by costing alternative instructional delivery systems, or modifications within those systems.

d. The effectiveness data is generated through two sources; internal and external sources:
   1) Internal sources could include data from faculty and students, and from program or course monitors (currently, almost all of this data is judgemental).
   2) External data would be collected from graduates and their employers (other data could come from state and national accrediting agencies).

e. Graduates and employers are willing to respond to well designed questionnaires, survey instruments, or interviews when clearly tied to their respective needs.

f. Specific questions to graduates or employers about the usefulness of specific knowledge or skills for accomplishing either professional work, or increasing the quality of their lives, could provide valuable information for making decisions about modifying the curriculum.

g. For internal data, the principle of successive approximation will probably have to be invoked, because this kind of data is very hard to get.

h. Regardless of the reasons (and several have been identified) faculty are very sensitive about sharing achievement and additudinal assessment data on their courses and students.

i. In retrospect, the time and resources required to either convince or coerce faculty into sharing their tests or test data has not been feasible in the past. Perhaps eventually, after a gradual establishment of testing skills in the faculty and trust of the system using that data, it will be possible to include this data as input into the process of program evaluation.

j. Still difficult, but considerably less difficult than getting test data from the faculty, is getting course evaluation data from students.

k. Most program coordinators require faculty to collect data from the students about their judgement of how well the course met expectations. The value of student feedback for improving instruction has been questioned by a number of researchers (Potem and Glasman, p. 497). Most of this data never sees the light of day. In the majority of cases, decisions to use or not to use such data lies entirely with the instructor. There is no pressure to use the data, and instructors tend not to.

l. Administrators will have to bite the bullet on this one, and insist that they have access to student generated course evaluation data. It will cost resources and probably some goodwill to collect it. The best way of getting this data will vary from campus to campus, and from college to college, but it must be done.

m. A second problem, given that such data can be had, resides in the usefulness of student-generated evaluation data. Unfortunately, the instruments for collecting student evaluation data are seldom specific enough for purposes of identifying needed changes. (Berquist and Phillips, p. 47).

n. It is difficult to change these course evaluation forms used by students, but sometimes additions are possible. Probably, the best addition that can be planned for initially, is to have the course objectives listed, with directions to the students to indicate each objective's usefulness, and how well they learned the skill, knowledge, or attitude explicit in the objectives.

o. This is still judgemental data, but even data at that level would give IDers and others responsible for program and course improvement, a place to stand.

p. This data, along with external data from graduates and their employers, could be arrayed by the computer as part of the analysis of what, if anything, about the instructional delivery system needs to be changed.

q. After revisions are made, new data from similar sources can be compared with past data as a means of determining the effects of the revisions carried out by IDers and others.

This outline suffers, as do all outlines, from a dearth of substance. Paulson, as paraphrased by Abedor (p. 37), identified six classes of data needed for evaluation of individual courses. These were: 1) antecedent data (entry behaviors), 2) technical data (quality of instructional stimuli), 3) process data (interim student behavior assessment), 4) learning data (student progress toward course objectives, 5) criterion achievement data (responses to posttest achievement instruments) and 6) attitudinal data (ratings by students and others regarding the merit of course aspects). Given the need, ideally, for all of these types of data, the sufficiency of additudinal (judgemental) data, even though collected in terms of specific course outcomes, can be questioned. Again, this scheme is at best only a partial solution, but its value lies in the potential for opening up the system to acquire the other forms of data. The same position is held when developers look beyond individual course data to the broader concept of program evaluation. The requirements of Stufflebeam's CIPP model (pp. 19-25), requires data for four types of evaluation; context (for planning decisions) input (for design and resource decisions), process (operations control decisions), and product (for results and recycling decisions). Similar kinds of statements could be made for other types of evaluation data, recognized in the literature, and presumably needed to evaluate courses and programs. Some of the recommended data is available to IDers, much of it is not. The question remains, "where is a useful place to begin?" Perhaps this outline. Below are listed the major tasks implied by this proposal:

*1. Collect missions, goals and objectives
2. Generate program hierarchies
3. Complete discrepancy analyses
4. Write and rewrite missions, goals, and objectives, as necessary
*5. Change student course evaluation forms and gain access to student evaluation data
6. Gather data from graduates and employers
*7. Set up EDP system to handle data
8. Use computer to sort objectives as; incomplete, duplicates, missing, inappropriate or poorly met
*9. Foster revision decisions, revise and recycle
10. Collect data on revision effects and make visable to decision-makers.

Given that instructional developers can agree on the major arguments and elements of the outline, there is still a lot of meat to be put on the bones. Implementation will undoubtedly require a sharing of the tasks of development. Recommendations that might be considered include:

1. Strong debate among instructional developers and other educators, including evaluation specialists, to work out appropriate techniques,
2. The formation of a professional consortium of instructional developers to share in the process of implementing instructional program evaluation systems that would incorporate the proposed elements.

*Key tasks, with high degree of difficulty

3. A division of labor among the consortium members for accomplishing the necessary tasks to reduce unnecessary duplication of effort.

In turning again to the elegant extant program evaluation models (Scrivens, Stufflebeam, Stake, Provus, etc.), it is suggested that this proposal, if implemented, would be a successive step toward their effective implementation. The evolution toward a pervasive approach to evaluation like that suggested by Tennyson (p. 19) and others, should be assisted by the foothold that the implementation of this plan could provide.

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Research in Progress: Toward a Procedure to Identify the Spontaneous Memory Strategies of Children

Michael J. Hannafin and James O. Carey

Department of Educational Technology
Arizona State University

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Abstract

Third-and-fourth grade students were administered a learning strategy screening in an attempt to determine: 1) their ability to describe individual learning strategies used to remember presented words, 2) the classifiability of student learning strategy descriptions as primarily visual or verbal, 3) the feasibility of using multiple student learning strategy descriptions to establish the dominance of either verbal or visual strategies, and 4) the effects of different learning strategies and visual-versus-verbal presentations on abstract and concrete prose learning. Three generic responses for visual strategies and three generic responses for verbal strategies were derived from open-ended student responses. The results suggested that high achieving students demonstrated a better facility to describe their strategies than low achieving students; however, among students whose responses were readily classified as visual or verbal, no significant differences in achievement were found. Learning strategy, as defined in this study, was not found to be a significant factor by itself or in moderating the effectiveness of either visual or verbal prose presentations. However, individual learning strategy as an actively cultivated skill may produce effects that are not apparent when approached as a passive learner trait.

RESEARCH IN PROGRESS: TOWARD A PROCEDURE TO IDENTIFY THE SPONTANEOUS MEMORY STRATEGIES OF CHILDREN

Considerable research has been conducted related to the effectiveness of different types of media and elaborative techniques in improving student learning. As Salomon and Clark (1977) have suggested, the emphasis in media research has begun to shift from the media itself to the types of presentation stimuli, the types of learning tasks to be conveyed in the presentation, and the types of learners for whom the presentation is intended. However, apart from reported ability effects (Willows, 1978; Carey & Hannafin, Note 1) and age-related effects (Jusczyck, Kemler, & Bubis, 1975; Guttman, Levin, & Pressley, 1977; Christie & Schumacher, 1978) learner variables have received little attention. The purposes of the present study were: 1) to develop a conceptual framework for studying one such variable, the personal and spontaneous memory strategies of children, 2) to report progress toward empirically identifying such strategies, and 3) to investigate the relationship of the individual memory strategies to different modality presentations of the same information.

While substantial attention has been directed to presentation stimuli variables, (e.g., Levin & Lesgold, 1978; Peng & Levin, 1979; Rusted & Coltheart, 1979), the role of individual learning strategy in moderating the effectiveness of various presentations has received considerably less attention. Levin, et. al (1974) found that students' ability to profit from verbal and/or picture presentation may be partly a function of a learner predisposition, i.e., students may be likely to profit to a greater extent from media that are consonant with their predisposed learning style. Filan (Note 2) interviewed students individually to identify visual or verbal learning strategies, imposed either a compatable or an incompatable visual or verbal mental imagery procedure, and presented either a pictorial or verbal representation of nouns in isolation. While Filan found no presentation-by-learning strategy interaction for word recall, the question of how much learning style interacts with prose presentation stimuli remains of interest.

The degree to which the type of information to be learned is affected by presentation and learning strategy variables is also unclear. Research has suggested that learner recall is influenced by the concreteness or abstractness of the information to be learned, i.e., the more concrete, the easier to recall (Paivio, 1971). Since prose also presents unique learning requirements, such as contextual and inferential learning, the interaction between learning strategy and visual and verbal prose presentation variables could produce unique effects.

The relationship between the type of externally induced or imposed memory strategies (e.g., verbal, visual) that are commonly used to facilitate recall and the spontaneous learning strategies of the same student has not been well-established. In some cases, researchers have reported that students spontaneously apply their own individual learning strategy, and in doing so perform more effectively than students who are experimenter-trained in an externally imposed memory strategy (Carlson, et al, 1976). Yet, comparatively little is known regarding the individual strategies that are used spontaneously by students. Student learning may be dependent upon the relationship between the strategies whether imposed, induced, or spontaneous and the modality of an information presentation rather than to the media itself.

The implications of accurately identifying the memory strategies used by children are many: 1) little or no additional memory strategy training might be needed, 2) differences between individual learning strategies and other elaboration techniques could be avoided if detrimental, or encouraged if facilitative, 3) attention could be focused on the students processing any mediated information using individually reinforced personal learning strategies rather than continually modifying mediated presentations to accomodate specific assumed needs, and 4) students could be trained to cultivate the learning strategies already internalized. As Salomon and Clark (1977) have suggested, perhaps learner variables such as learning strategy are sufficiently potent to warrant continued investigation--particularly as such strategies impact the activities of the media developers.

An experiment was conducted in an attempt to develop group administered procedures to identify the learning strategies used by children and the effects of such strategies on the learning of prose. The purpose of the experiment was: 1) to establish the relative ability of third-versus-fourth grade students to verbalize, by writing open-ended descriptions of how given words were remembered, the individual uncued strategies used to remember concrete nouns, 2) to establish the classifiability of the openended written responses as predominately verbal or visual strategies, 3) to establish a conservative method for classifying students as having verbally or visually dominated individual learning strategies, and 4) to examine the effects of different learning strategies and visual-versus-verbal presentations on prose learning.

Methods

Subjects

A total of 144 third-grade students and 152 fourth-grade students served as subjects. Students attended one of three different elementary schools in a middle-class school district.

Materials and Criterion Measures

A five-minute learning strategy screening, which consisted of directions for completing the screening, a practice exercise, and the presentation of five concrete nouns, was used to identify each student's learning strategy. Students were directed to 1) remember what was presented (by the examiner) for 5 seconds, 2) write what was presented on a slip of paper provided for this purpose, and 3) write how they remembered on the same slip of paper. All directions were given without reference to the terms "word" or "object" to avoid cuing the students to either a verbal or visual response. The learning strategy screening was presented and paced via audiotape.

The prose presentation was an adapted version of Bill Peet's Wump World (1970). Three 15-minute presentations of the story were used in the study: ORAL, a verbal-only transcription of the adapted story on audiotape; PICS, a visual-only 35mm slide presentation of the story, including close-up slides of all criterion information; and ORAL + PICS, a combination of the verbal and visual stimuli. The presentations for the third grade versus the fourth grade varied only in the duration of, and directions during, the embedded pauses that were used to assist students in remembering the story. The story presentations, per se, were identical for all students. Within each grade all presentations were paced identically to control

time-on-task. Because of the slight differences, data from each grade were analyzed separately; comparisons of third-versus-fourth grade were subsequently made using the performance trends of each grade.
All criterion information was systematically "loaded" into both ORAL and PICS presentations, i.e., all criterion concepts were systematically emphasized in each presentation, to ensure that opportunities for exposure to all key information was available in each presentation.

The criterion test was a 28-item constructed response test. The test, which included 14-abstract items and 14-concrete items, contained only information included in the prose presentation. The criterion test was presented and paced via audiotape. Student answer sheets were also provided.

Procedures

Students were randomly assigned within their grade level to one of the three presentation conditions. Prior to the presentation, students were administered the learning strategy screening. Upon completion of the screening, student response slips were collected, and the story was presented. The presentations were conducted concurrently within each grade/school to avoid students gaining knowledge of the presentations prior to seeing and/or hearing the story during the study in their assigned group. The presentation was followed by a brief interpolated task which consisted of standing at assigned seats and distributing criterion test answer sheets to students. The criterion test was then administered. The total time required for completion of these activities, including off task time, averaged approximately 45 minutes.

Students were classified as using VERBAL, VISUAL, or CAN'T TELL learning strategies using the following post-hoc procedures: 1) student written responses were classified via a "blind" procedure, where responses were classified without regard for presentation by three trained evaluators, 2) only individual responses that were clearly classifiable as VERBAL (e.g., "said the word over and over") or VISUAL (e.g., "made a picture of it in my head") were classified accordingly, and 3) students were classified only if a minimum of 80% of their responses to the five screening nouns were clearly classifiable as VERBAL or VISUAL. In cases of doubt or mixed VERBAL-VISUAL responses students were always assigned to the CAN'T TELL learning style group.

The criterion test was readministered exactly two weeks after the presentation for a measure of delayed recall.

Results and Discussion

Table 1 includes a ranked list of the most frequent generic responses reported by students describing how presented words were remembered. Since students frequently used variants of the same response, such variants were classified as the generic responses reported. Third-and-fourth grade students reported virtually identical "generic" responses, and reported them with nearly the same frequency.

The distribution of students-by-grade classified as reporting VERBAL, VISUAL, or CAN'T TELL learning strategies is illustrated in Table 2. As expected, fourth-grade students were more effective than third grade students in describing the learning strategy used to remember the presented words. Using the Kolmogorov-Smirnov comparison of distribution, the learning strategy destributions of third and fourth graders not significantly different ($p > .10$). In effect, although a substantial number of students for each grade were designated CAN'T TELL, the proportions in

Table 1

Rank Ordered List of Three Most Frequent

Visual and Verbal Generic Learning Strategy Responses

	Learning Strategy	
Rank	Visual	Verbal
1.	I made a picture in my mind	I said the word over and over
2.	I saw one	I made up a sentence with the word
3.	I remembered it from a movie or TV show	I thought of the word and what it means

Table 2

Distribution of Students-by-Learning Strategy by Grade[a]

Grade	VERBAL	VISUAL	CAN'T TELL	Totals
Third	38 (26%)	23 (16%)	83 (58%)	144
Fourth	52 (34%)	23 (15%)	77 (51%)	152
Totals	90 (30%)	46 (16%)	160 (54%)	296

[a] percentages computed within grade

each strategy were not different from grade-to-grade.

The mean achievement test scores by grade for each learning strategy are included in Table 3. As shown, students reporting either VERBAL or VISUAL strategies scored higher than CAN'T TELL students on a test of language achievement. However, no differences were found between students reporting VERBAL versus students reporting VISUAL strategies. Because of the achievement differences among the learning strategy classifications, achievement scores were used as a covariate in the analysis of criteria test recall scores.

The patterns of student criterion test performance were identical for third-and-fourth grade students. Mean scores for recall of abstract and concrete prose for third grade and fourth grade students are included in Table 4 and Table 6 respectively. The source data for grades are included in Table 5 and Table 7. As illustrated, the covariate, language achievement, accounted for a significant amount of the score variance; for both grades, when partitioned out, differences were not obtained as a function of reported learning strategy. However, the presentation modality yielded significant differences in the recall of concrete and abstract prose. For both grades, recall of both concrete and abstract prose was significantly greater for the combined ORAL + PICS presentation than either ORAL ($\underline{p}<.001$) or PICS ($\underline{p}<.001$) presentations. Although no differences in recall of abstract prose were obtained between ORAL and PICS, PICS resulted in significantly greater recall of concrete prose for both third grade ($p<.0001$) and fourth grade ($\underline{p}<.0001$).

Conclusions

The study of individual learning strategy offers a complex yet potentially fruitful pursuit. The procedures employed in the present study were designed to identify the ways in which children describe

Table 3

Mean Overall Language Percentile[a] Scores for Learning Strategy-by-Grade

	Learning Strategy			
Grade	VERBAL	VISUAL	CAN'T TELL	Totals
Third	66.24	68.87	53.25	59.17
Fourth	53.31	60.78	40.48	47.74

[a] As measured by the Language subtest of the Stanford Achievement Test

Table 4

Mean Repeated Measure Abstract (A) and

Concrete (C) Scores for Third Grade Students[a]

		Presentation			
Learning Strategy		ORAL	PICS	ORAL + PICS	Total
VERBAL	A	4.42	6.33	8.67	6.28
	C	5.21	8.35	10.95	7.98
VISUAL	A	5.93	5.45	8.07	6.39
	C	7.36	7.45	8.72	7.80
CAN'T TELL	A	4.28	4.78	7.50	5.47
	C	5.43	6.24	8.85	6.77
Totals	A	4.53	5.44	7.84	5.83
	C	5.63	7.20	9.27	7.25

Summary:

Presentation	Abstract	Concrete
ORAL	4.53	5.63
PICS	5.44	7.20
ORAL + PICS	7.84	9.27

Learning Strategy	Abstract	Concrete
VERBAL	6.28	7.98
VISUAL	6.39	7.80
CAN'T TELL	5.47	6.77

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[a] not adjusted for influence of covariate

Table 5

Mean Repeated Measure Abstract (A) and Concrete (C) Scores for Fourth Grade Students[a]

		Presentation			
Learning Strategy		ORAL	PICS	ORAL + PICS	Total
VERBAL	A	6.29	5.83	9.27	6.95
	C	7.96	8.09	10.54	8.63
VISUAL	A	6.72	6.90	9.61	7.89
	C	6.78	9.40	10.61	8.85
CAN'T TELL	A	5.29	5.40	8.08	6.42
	C	6.98	8.26	9.14	7.95
Totals	A	5.89	5.73	8.67	6.82
	C	6.60	8.30	9.77	8.32

Summary:	Presentation			Learning Strategy	
	Abstract	Concrete		Abstract	Concrete
ORAL	5.89	6.60	VERBAL	6.95	8.63
PICS	5.73	8.30	VISUAL	7.89	8.85
ORAL + PICS	8.67	9.77	CAN'T TELL	6.42	7.95

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[a] not adjusted for influence of covariate

Table 6

Source Table for Repeated Measure Abstract (A)

and Concrete (C) Mean Scores for Third Grade Students

Source	Scale	*df*	MS	F	*P*
Covariate (Language Achievement)	A	1	237.89	44.30	.0001
	C	1	416.68	79.52	.0001
Presentation	A	2	124.39	23.16	.0001
	C	2	138.73	26.48	.0001
Learning Strategy	A	2	1.94	.36	ns
	C	2	4.79	.91	ns
Presentation and Learning Strategy	A	4	1.64	.31	ns
	C	4	2.02	.39	ns
Error	A	134	5.37		
	C	134	5.24		

Table 7

Source Table for Repeated Measure Abstract (A) and Concrete (C) Mean Scores for Fourth Grade Students

Source	Scale	*df*	MS	F	*P*
Covariate (Language Achievement)	A	1	999.27	58.85	.0001*
	C	1	1201.65	76.93	.0001*
Presentation	A	2	567.60	33.43	.0001*
	C	2	504.85	32.33	.0001*
Learning Strategy	A	2	8.53	.50	ns
	C	2	.89	.06	ns
Presentation and Learning Strategy	A	4	1.34	.08	ns
	C	4	10.46	.67	ns
Error	A	142	16.98		
	C	142	15.62		

how they remember and to determine whether or not such children reported similar types of strategies over different stimuli.

The use of a group administered open-ended, written response by third-and-fourth grade students to describe their memory strategy appears less than satisfactory. Due to the writing skills required, students capable of describing their strategies tend to be high-achieving students; in effect, the writing task seemed to limit the ability of many students to convey their learning strategies assuming such strategies are consciously applied. The procedures did, however, result in a list of generic responses used by students to remember presented information. The generic responses were quite similar to those obtained by Filan (Note 2), who obtained the responses from a full range of students. Because of this agreement, and because Filan's findings suggest that students tend to report similar learning strategies regardless of high-versus-low achievement, it is possible that a group administered learning strategy screening could be implemented using a response selection procedure.

The finding that recall differences are not attributable to visual-versus-verbal learning strategies is noteworthy. It is presently unclear whether students employing either visually or verbally dominated learning strategies should demonstrate superior recall of presented information. Should learning strategy be a significant variable in affecting student learning, it is possible that such differences would be in the form of presentation modality-learning strategy interactions. However, such interaction were not found in the present study. It is possible that reported learning strategy is simply less potent than many other learning variables in affecting recall. However, it is also possible that individual learning strategy is a phenomenon that may manifest itself only when actively and consciously cultivated, and may become subordinate to the demands of stimulus bombardment when not actively and consciously encouraged.

The results of the present investigation suggest that group administered procedures for identifying the individual memory strategies of children may be possible, but the effects of such strategies on learning may be more a function of the degree to which given strategy is incorporated during stimulus input than whether or not a student reports visual or verbal learning strategy tendencies. Further refinement of the identification procedures and further study on the effects of the cultivation of individual learning strategies is needed.

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Content Treatment Interactions:
A Better Design Model[1]

David H. Jonassen
University of North Carolina at Greensboro

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[1] The author expresses appreciation to Lawrence Brink for reacting to an earlier draft of this paper. Requests for reprints may be addressed to:

David H. Jonassen
School of Education
University of North
Carolina at Greensboro
Greensboro, NC 27412

Abstract

Instructional design is traditionally premised on attention to learner behavior, i.e., task analysis. Differential psychology has advocated adjusting instruction to conform to individual differences in task performance. Many instructional designers have adopted aptitude-treatment interaction methodologies as a design paradigm. Conceptual and methodological problems inherent in ATI research, coupled with the impracticality of its application, calls into question its use as a design model. This paper proposes to de-emphasize ATI as a model, de-emphasize learner characteristics in instructional system design, and refocus attention on the structure of content and the differences in the information processing required to assimilate it. These changes would effect the design field by replacing traditional behavioral task analysis with content analysis. Designers would seek to accomodate differences in the content, not in the learners. The dividends from research would be more readily applicable to material design and would probably produce greater overall effects. This paper does not intend to refute the existence and importance of individual differences, merely to stimulate dialogue about their implications for instructional design vis-a-vis the nature of subject matter content and its information characteristics. The ideas presented in this paper are intended only to instigate discussion; they are not intended as preclusive answers. Too often that mistake has led us up the blind alley of advocacy.

Content Treatment Interactions: A Better Design Model

Individual Differences and Instructional Design

Task and Learner Analysis

The historical, psychological foundation for instructional design constitutes the practice of task analysis. The practice includes analyzing goal states in terms of the component learner behaviors that if properly sequenced lead predictably to some pre-stated terminal criterion. Emerging to preeminence with programmed instruction, task analysis sought to shape the learner's behavior to emulate the task description. Although Davies (1973) identified six types of task analysis, the predominate method was based on behavioral analysis. In planning for instruction, behavioral task analysis specifies the order of prerequisite capabilities (learning structure) that will most efficiently yield the prescribed terminal behavior (Gagne, 1970). Learning is conceptualized as associative and cumulative. So task analysis seeks to facilitate vertical transfer up the behavioral hierarchy, that is, to facilitate the acquisition of a series of approach behaviors.

This focus on learner behavior germinated a concurrent interest in learner analysis over a decade ago. Whereas task analysis specifies only task-related instructional conditions and sequence, learner analysis attempts to specify the learner characteristics that can be combined with task analysis to facilitate learning (Schwen, 1973). The intent became to shape the task to the learner, not vice versa. The research methodology that was readily adopted to identify those combinations examined aptitude-treatment interactions (ATI). These techniques emerged in the design field as a replacement for the use of normative instruments for selection and placement with criterion-referenced data for assessing learners and monitoring their behavior in task sequences (Schwen, 1973). Not only were achievement-related abilities being compared with instructional methods, but also specific personality traits, cognitive styles, and information processing and coding strategies (Snow and Solomon, 1968). A new dimension had been added to task analysis procedures. Fueled by the revolution in learning theory resulting from differential psychology, analysis of individual differences and their interaction with design strategies added the concept of learner analysis to the lexicon of the instructional developer.

Aptitude-Treatment Interactions

The concept of aptitude-treatment interactions is one of the best known in the educational research field today. Its genesis dates back almost a quarter of a century, when Cronbach (1957) used a correlational approach to relate individual differences and experimental approach. After a decade of solidification, Cronbach and Snow (1969) laid the groundwork for contemporary ATI research by suggesting methodological and conceptual guidelines for its conduct. In essence, ATI is a methodological paradigm that seeks interactions between alternative aptitudes (Cronbach & Snow, 1969), attributes

(Tobias, 1976), and/or traits (Berliner & Cahen, 1973). Although these terms make different assumptions about inclusiveness, aptitude is the most common designation. Aptitudes may include any personological variable, including general intelligence, prior learning, personality, or cognitive styles, on which individuals differ. Treatments consist of the structural and presentational properties of the instructional methods. Interactions may occur between aptitudes and treatments when individual differences in the former predict different outcomes from alternative treatments. That is, instructional methods may facilitate learning or they may inhibit learning, depending upon the instructional treatment. Generalized regression analysis is used to produce slopes by regressing the dependent variable (outcome variable) on the aptitude variable. Statistical differences between the slopes indicate either an ordinal interaction or a disordinal interaction, which most researchers believe is the most meaningful. The implication of ATI for instructional decision making is as a guide for assignment of learners to treatment condition. (Cronbach & Snow, 1977) suggest that learners with aptitude scores greater than that adjacent to the point of intersection be assigned to one treatment, those with lower aptitude scores to the other, to maximize learner output. Such an assignment may lack the reliability that can be affected by determining the regions of significant differences of outcomes (Berliner & Cahen, 1973). That is, differential assignment to

Treatment A is reliable for aptitude scores somewhere above the intersection of regression lines. Conversely, the region-of-significance for assignment to the alternate treatment is somewhere below the intersection. Cahen and Linn (1971) review a number of statistical techniques for determining those regions. For an elaborate review of the ATI research paradigm, the reader is referred to Cronbach and Snow (1977).

As ATI research grew in popularity, its implications for instructional designers became obvious. Individualization of instruction had historically described efforts to accommodate only the pace of instruction (programmed instruction, personalized system of instruction, etc.). The opportunity to accommodate individual abilities and styles was replete with design potential. Models for relating treatments to learner's abilities and traits based on ATI were suggested: remediation of learner's deficiencies, compensation for deficiencies by modelling cognitive behavior, and preference, capitalizing on learner strengths (Salomon, 1972). Although these were intended only as a heuristic for generating ATI hypotheses, they formed the basis for the matching model of instruction. Additional methods for matching methods to learners, based on individual differences and the existence of aptitude-treatment interactions, included combination matches (combinations of above) and challenge matches, in reality mismatches that challenge the learner to acquire necessary but currently deficient mental skills (Messick, 1976).

Believing that "the ATI concept is best applied, not in isolation but as an integral part of the dynamic decision-making instruction environment" (p. 33), Parkhurst and McCombs (1979) developed a rationally and empirically-based ATI instructional design model. The major steps of the process include:

1. Establish main track (best method) modules.
2. Establish student characteristics (related to criterion performance) data pool.
3. Evaluate main track performance for excessive failure rates/variance.
4. Develop alternative modules based upon predictor/criterion variable relationships.
5. Evaluate alternative modules in terms of cost effectiveness.
6. Implement differential assignment of students to alternative modules and monitor.

The model advocates consideration of a broad spectrum of predictor variables, including cognitive skills, achievement motivation, personality, and acheivement characteristics. A potential shortcoming is its reliance on a "best method" with alternative mediation or modelling (compensation) of deficient skills. Considering the myriad variables suggested above, is a "best method" ever possible? Are the assumptions substantively different than for traditional instructional approaches? The model is conceptually sound. However, it is questionable whether or not it, as a representative ATI design model, is practically possible for reasons to be considered next.

Deficiencies in ATI Research

A number of basic problems with ATI research, in addition to methodological weaknesses related to validity and reliability of individual studies, militate against its generalized application as a design model. The following review of these problems is global; an exhaustive review would require several hundred pages, as Cronbach and Snow (1977) proved. While many of these problems are interrelated, individual enumeration will focus attention on the scope of the problem.

1. ATI research is largely atheoretical. While a major goal of aptitude-treatment interaction research has been the derivation of explanatory principles concerning the nature of instruction (Salomon, 1972), most studies have focused on the predictive relationships of aptitudes in the differential assignment of subjects to treatment. ATI have been largely empirically based, insensitive to the belief that "understanding of the psychological processes of a specific learning task is prerequisite to the development of a theory on the interaction between traits and treatments" (Berliner & Cahen, 1973, p. 59).

The absence of an adequate conceptual basis for selection of aptitude variables for research has resulted in a shotgun approach. For instance, Seidel (1973) administered 27 instruments measuring 35 variables in an effort to generate significant ATIs. Researchers need to better specify the nature of the treatments and attributes. Tobias (1980) suggested a taxonomic scheme for thoroughly describing the methods for classifying treatments and learner aptitudes. Salomon (1979) applied his own heuristic model for generating ATI hypotheses (Salomon, 1972) in a series of studies which modeled the information processing characteristics measured by the aptitude variables in his treatments. Even though current ATI research has refocused attention to the processing characteristics of aptitudes and the cognitive structural characteristics of task and achievement (Snow, 1980), the existing ATI research base is not generally theoretically based. Rather, hypotheses are still mostly a posteriori. As the theoretical transition of instruction design to a cognitive science (Merrill, et al, in press) becomes more complete, the meaningfulness of much of the existing ATI research will diminish. Current consideration of the information processing components of the instructional task is auguring the usefulness of meta-cognitive strategies as design components (Brezin, 1980).

2. ATI results are inconsistent. Tobias (1980) concluded from several studies that ATI were generally inconsistent. Significant interactions are counterbalanced by more non-significant treatment differences. Very few replications of ATI research have yielded significant interactions. In fact, many replications have reversed the findings of the previous study or were followed by non-significant differences. Tobias has also found that different researchers evaluating the same aptitudes or treatments produce dissimilar results. When ATIs do occur most are not strong, i.e., they are ordinal and

therefore not useful for differential assignment. Results are often isolated and artifactual.

3. ATI results lack generality. In addition to the lack of consistency, most ATI results cannot be generalized to similar populations. They lack external validity. Many ATI studies are not classroom-based. They also lack ecological validity. In studies that are classroom-based, multiple interactions occur between treatments and classroom contexts (Brophy, 1979). Context plays an important, though often undetected role in most learning. The very nature of interactions both among and between aptitude variables and instructional conditions are so complex as to render generalization impossible (Snow, 1977). It is impossible "to store up generalizations and constructs for ultimate assembly into a network" (Cronbach, 1975, p. 123). A generalizable theory of aptitude-treatment interactions is not possible. Learning is too context-specific. At best we can hope to develop local instructional theories related to local instructional situations concerned with small portions of the curriculum and small segments of the population (Snow, 1977). Snow concludes that it is possible, through continuous, systematic, formative evaluations of ATIs over time in a given place to generate a dynamic instructional theory for that place that could not generalize to another.

4. ATI also interact with task characteristics. To further militate against generalizability, ATI also interacts with processing characteristics of the criterion task to

produce complex performance differences (Rhetts, 1974). He found that error rates were higher but response latencies shorter for impulsive learners, with opposite results for reflectives. Rhetts (1972) recommended, in fact, that designers first concentrate on the task characteristics (e.g., demands on memory) and then identify the individual difference variables that may be related to those characteristics. Treatments should derive from the interaction of those two variables. Can designers effectively accommodate aptitude x treatment x context x task interactions in designing instruction for each objective?

5. Intelligence is the preeminent aptitude. From countless studies, general mental ability has emerged as the strongest and often the only predictor, sometimes even when it wasn't being measured (Jonassen, Note 1). After general intelligence is removed, little variance in dependent scores is left, so ATI are often hard to find (Berliner & Cahen, 1973). Although interactions between treatments and such variables as prior learning (Tobias, 1976) and anxiety (Tobias, 1977) do exist, their relative contributions to learning are normally less than mental ability (intelligence) and therefore probably less cost effective. It is doubtful that significant attributes would be of equal importance to instruction in different areas (Tobias, 1976).

6. Applying ATI to instructional design. Although the ATI hypothesis was never meant to be an instructional design model, its implications have been repeatedly considered. How

should ATI be implemented in the design of instruction? What types of matches are the most productive in a given instructional situation? While Salomon (1979) found that compensatory matches produce more positively consistent results than capitalization or remedial, he also believes that it is essential to challenge learners in order to cultivate development of important mental skills. The type of match that is affected by the materials designer will determine the portion of the learner population you wish to serve. The designer is forced to develop three or four versions of each instructional sequence to provide alternative matches for different learners or else make a value judgment about which need is greatest.

7. Accommodating individual differences resulting from ATI is impractical, if not impossible. The complex nature of ATI research in general, manifested in the large number of higher order interactions that inevitably occur when the range of significant predictor variables, are considered make such individualization impossible. The logical implication of ATI research is to provide for individualized programs of instruction. Different instructional sequences would be designed for learners who differ in terms of attributes (personality, intellectual, prior learning, etc.) and be implemented in different contexts to teach each objective which varies as to type of learning required (task characteristics). It should be obvious that the number of alternate treatments required just to fulfill a small part of the curriculum would be phenomenal. Resources don't exist to support local generation

and production of such materials in schools at any level. It is doubtful that even well-funded, task-specific industrial training situations would justify the degree of individualization suggested by achievement-, aptitude-, and trait-treatment interactions. This problem appears to be an irreconcilable issue, even if the other obstacles and deficiencies in ATI research and design can be overcome.

As Shapiro (1975) suggested, commercial producers won't support such efforts to individualize, because it would not be profitable. The economics of publishing compel producers to develop "best method" materials to accommodate the broadest range of learners.

The only way to manage and deliver such a program of individualization would be by computer-managed instruction. Resource limitations would prohibit local agencies from developing and testing the software and instructional treatments needed to implement a program. While the most consistent instructional decisions resulting from ATI occur at the local level, the greatest economies in computer-based instruction are achieved on a macro level. CMI may not become a viable delivery system for a while.

Content Structural Approach to Design

Cognitive Task Analysis

Two approaches to task analysis of subject matter exist (Seidel, 1973). Task analysis, as it is traditionally conceived from a behavior context (discussed earlier), refers to the development of hierarchical task structures (Bloom, et al, 1956; Gagne, 1970). These structures sequence learning by identifying the necessary prerequisite behaviors that will lead ineluctably to higher levels of performance. They determine what a learner must be able to "do" prior to performing some more difficult task. The other approach to task analysis analyzes content structures, i.e., identifying what the learner must "know" before being able to know something else. This approach is alternatively referred to as content analysis. Certain dependency relations between content constituents are necessary to consider when sequencing learning (Kingsley & Stelzer, 1974). These relations can be graphed to form a general cognitive network which is then related to tasks derived from objectives to form the subject matter structure.

The importance of both task analysis orientations in any instructional design model was stated by Pask (1969). Rather than integrating the two in a design model, Merrill (1973) assumed that content structure and instructional sequencing were completely independent. Control of sequence should be left to the learner (Merrill, 1975). Research findings (Seidel, 1973; Tennyson, 1980; Tennyson & Rothen, 1980) have failed to support the effectiveness of learner control of instructional sequence, especially for more complex content. Instructor controlled instruction has consistently produced more positive results. The implication is that content structure, especially for concept acquisition tasks, should be used to determine instructional strategy.

The emergence and application of learning theory derived from cognitive psychology to instructional design has shifted focus away from the behaviorally oriented task performance specification and hierarchical sequencing. Attention is now being focused on the internal information processing requirements of the task to be learned. Analysis of instructional tasks in terms of formal psychological models is the newest application of cognitive psychology to instruction (Gallagher, 1979).

Cognitive task analysis makes a different set of assumptions about learning than do strictly behavioral approaches. The latter are concerned with sequencing the behaviors of learners in order of difficulty to optimize acquisition of the behavior. According to Resnick (1976), this process resembles the operant conditioning principle of successive approximations. Cognitive task analysis, on the other hand, seeks to identify and order the internal information processing operations required to perceive, store, access, and operate on the knowledge. To this end, she has constructed a cognitive model of task analysis -- rational process analysis. Rational task analysis, an amalgam of Gestalt, cognitive, behavioral, and information processing theories, describes in detail an "idealized" set of operations derived from subject matter structure, i.e., content. These operations and the psychological abilities necessary for their performance are analyzed and sequenced for optimal performance. This approach to content analysis makes few assumptions about the individual processing limitations of learners. It functions as an information processing model for the accomplishment of cognitive objectives (Greeno, 1976) and the consequent knowledge acquisition. The key to content analysis is that in any learning situation, a description of the psychological operations must include representations of the specific content and the operations on it by the learner (Gregg, 1976).

The product of learning is the arrangement of ideas in an individual's cognitive structure. Task analysis as performed by the instructional designer should consider the appropriate sequence of internal processes necessary for constructing the appropriate cognitive structure in the learner, a process that can be accomplished rationally (analytically) or empirically (Winn, 1978). The designer must understand the structural relationship between concepts that form the content, i.e., content structure. Content structure analysis requires the application of rational techniques of task analysis. The most popular methods for performing rational task analysis, active structural networks (Norman, Rummelhart, and LNR, 1975) and digraph analysis based on the theory of directed graphs (Harary, Norman and Cartwright, 1965; Shavelson, 1972) seek to map the knowledge structures or schemata that exist in memory or in prose respectively. Shavelson extended the techniques suggested by Harary, et al to empirically compare the content structure of a passage with the resulting cognitive structure developed in the learners. Understanding how to structure content is ultimately predicated on how we represent knowledge in memory. Most contemporary conceptualizations are based on schema theory (Rummelhart and Ortony, 1977), which conceives of memory as a cognitive network of schemata or internal representations of interrelated concepts. These schemata have variables and represent concepts at varying levels of abstraction which can be embedded within each other. As Winn (1978) suggested, designers engaged in task analysis need to concentrate on the process of learning and the product and structure of knowledge as well as the task being performed. Systems should focus on designs that will facilitate the construction of appropriate cognitive structures. The underlying assumption is that subject matter structure provides an important basis for sequencing and synthesizing instruction (Reigeluth, Merrill, & Bunderson, 1978).

Another dimension to content analysis, perhaps the most potentially productive, considers the nature of the symbol systems used to code a particular task.

When knowledge is communicated for instruction or any purpose, it is coded, and it is this code and its inherent structural properties that most greatly affect learning (Salomon, 1976). Olson and Bruner (1974) suggest that knowledge acquisition is always mediated through some form of human activity, that knowledge acquisition is dependent upon the learner's ability to transform the coded information into meaningful thought units, a process Salomon (1979) calls recoding. Converting coded information into internal mental codes is the focus of any structural design. The recoding process naturally requires the use of a variety of mental skills. As Salomon recommends, if you can encode information or select a set of learner activities that are isomorphic to the nature of the mental representations required to complete a learning task, acquisition of knowledge will be facilitated and mental skills developed. This principle is premised on the hypothesis that content presented by certain modes of representation, employing different symbol systems, will result in more effective instructional treatment. A recent study (Brink, 1980) found that by coding via different symbolic modes better conveyed critical features of concepts. Media (treatments) should be selected or designed on the basis of the ability of the symbolic mode of presentation to activate or model (supplant) the mental skills necessary for completing the task. Although Salomon's work concentrates on media codes, the principle can be generalized to task analysis. It is conceptually consistent with the other models of cognitive task analysis.

Task analysis based on the processes required for assimilating and using information is necessarily content specific. Learning content requires a sequence of mental tasks or operations. A component analysis of the operations implied by any content, therefore, is necessary to select and sequence content (Merrill, 1973). It follows that the structure of the treatment will affect the cognitive operations required to learn that content. The manner in which treatment characteristics interact with content characteristics implies a design model with a different focus than that implied by aptitude-treatment interactions.

Content-Treatment Interactions

If we assume that subject matter structures provide an important basis for how to sequence and synthesize instruction (Reigeluth, Merrill, & Bunderson, 1978) and that task analysis should describe the optimal internal mental processes of the learner based upon subject matter structure, then designers should be seeking instructional treatments (sequences, codes) that simulate those processes. Just as ATI assumes that no treatment is appropriate for all learners, a content-treatment interaction approach (CTI) assumes that no particular treatment modality is appropriate for all content. Since subject matter is defined by different types of content (facts, concepts, principles, problems) calling on different mental processes, instructional treatments coded or sequenced to simulate those processes must also differ. Instructional design would be well served by reviewing research on learning to determine how those processes vary and what the implications of those variances are for instruction. The purpose would be to design sequences of instruction with structural and coding properties as isomorphic to the mental processes required for learning material at different content levels. A CTI approach is premised on differences in content requirements predicting different outcomes from alternate treatments. In a number of studies, Salomon (1979) has found that instructional treatments that model or supplant the internal processing requirements of the task result in superior learning. In an exemplary study, Mayer (Note 2) found significant disordinal interactions between texts with and without advance organizers and degree of transfer required by the test and degree of organization required by the materials. Organizers facilitate far transfer but actually inhibit near transfer of learning. They facilitate learning from randomly organized text but inhibit learning from logically organized materials.

Learners should be assigned to the treatment that best simulates the content processing requirements which result in more efficient learning. The most obvious initial criticism of such an approach is that individuals don't all process information alike, so why instruct them all alike? Three reasons exist. First, because content process analysis has indicated that a certain sequence of operations are necessary for learning a specific type of content and that a particular sequence, as represented by the treatment, is the most efficient combination of processes. Second, human learners are very capable of adapting to specific task requirements, even though distinctive, individual learning styles do exist (Rhetts, 1972). Third, entry level learners deficient in certain mental operations will through appropriately structured treatments be able to cultivate them, a proposition that

Salomon has argued for a decade. The activation and/or development of mental skills is the foundation for all learning, regardless of how task-specific it may be.

Perhaps the most significant rationale for considering CTIs in instructional design is feasibility, For most cognitive objectives, such an approach would suggest "one best method." Such a notion is antithetical to recent pedagogical thinking. However, designing instruction that can teach a content objective as well as the mental skills required for its performance is preferable to the production of a potentially infinite number of treatments to teach different learner types. Is it educationally feasible to adapt instruction to each learner? Rather than shaping the treatment to individual differences in processing, why not shape the processing of individuals? It can be done far more efficiently. Unlike ATI which may also interact with the nature of the task performed on the content (Rhetts, 1974), CTIs are premised on the task by treatment interactions implied by the content. CTIs are based on the idea that cognitive task analysis of content would result in the identification of task-treatment interactions which would provide the basis for recommending treatment strategies. In no case would CTI approach the complexity of an aptitude x task x treatment generated strategy.

As with instructional designed based on ATI, CTI prescriptions would derive from experimental results. ATI is not and cannot provide the basis for a replete model of instructional design. Valid and reliable empirical findings can only supply designers with heuristics for assigning instructional treatments to specific types of learners. Likewise, CTI is not being posited here as a design model. The results of research can provide designers with a cognitive model for specific learning tasks, which can be translated into treatments. This analysis alone, however, is inadequate to function as the sole design criterion.

The remainder of the paper will review instructional methods and principles that have exhibited content-treatment interactions or possess unverified potential. This list is not exhaustive. In essence, they suggest ways for sequencing and presenting instructional treatments based on content structure characteristics.

Advance Organizers

The best known and most widely researched method for structuring content is through the use of advance organizers. Over two decades of research have confirmed their usefulness if applied properly. Based upon subsumption theory (Ausubel), 1962a), organizers function to bridge the gap between what the learner already knows (present cognitive structure) and what the learner needs to know in order to learn. Organizers provide the ideational scaffolding for incorporating a new piece of information into a person's cognitive schema (Ausubel, 1968), i.e., they activate the appropriate existing schema in the learner so that new information can be readily assimilated.

Presented "at a higher level of abstraction, generality, and inclusiveness" (p. 148), good organizers are concrete models, analogies, examples, and higher order rules (Mayer, 1979a). Ausubel (1960) first proposed the use of organizers to facilitate retention of verbal information, which provided the paradigm for a decade of research. The inconsistent results generated by this research led Barnes and Clawson (1975) to conclude that advance organizers do not facilitate learning. However, a recent meta-analysis of 132 studies indicated that organizers do in fact facilitate learning and retrieval (Luiten, et al, 1980).

These inconsistent results were probably caused by using the wrong research paradigm, i.e., looking at the effects of organizers on retention/recall. Ausubel's own concept of oblerative subsumption, the idea that recall of details and specific information defer to recall of the subsumptive points would suggest that the level of processing measured (i.e., type of task) is critical to the success of organizers. The basis for organizers was reconceptualized as assimilation encoding theory (Mayer, 1977, 1979a, 1979b) rather than subsumption theory (same theory with more elaboration). Assimilation theory requires for meaningful learning the reception of material into an existing assimilative context and the assumption that the learner will actively use that context during learning. Observed from this perspective, the use of advance organizers have generated several significant content-treatment interactions. Based upon a review of existing research, Mayer (1979a) found that organizers interacted positively with materials that are conceptual in nature, unorganized, and likely to be unfamiliar to learner. Organizers were more effective when they provided a high level context for learning and when the dependent variable was breadth of transfer and not retention. The results of a series of his own studies supported assimilation theory (Mayer, 1979b) and suggested interreactions of organizers with learning that requires far transfer as opposed to near transfer, discovery learning application of higher order rules, integration of premises, and the use of linear reasoning. Advance organizers understandably affect the structure of recall. Non-organizer groups tend to focus on detail rather than relating conceptual idea units. All of these results suggest the application of organizers and the consequent restructuring of learning materials based upon content analysis, not learner analysis. Designers could use organizers when the type of required learning or the form of materials dictated. Adaptations based upon specific, content-oriented, learner attributes might even function to refine the process. For instance, a learner could be given a pretest (word association, concept mapping, or patterning) to assess the relevance of his/her existing cognitive structure to the content. If it were adequate, assign a comparative organizer to establish an appropriate schema. If not, assign an expository organizer to establish an appropriate schema. The research base on advance organizers makes them probably the most readily implementable content-structured learning approach.

Elaboration Theory

Conceptually related to advance organizers is the elaboration theory of instruction. Elaboration theory (Reigeluth, 1979) prescribes a sequence of instruction consonant with organizers. Beginning at the broadest conceptual level, instruction provides the learner with an overview (epitome) of the subject, a context for presentation of all subsequent instruction. It elaborates on one part of the subject to a predefined level of detail, and then review the epitome, this time including the part just elaborated. The same sequence is repeated for each part of the subject. Once the epitome has been expanded to include all of the first level elaborations, each first level elaboration (only slightly more specific than the overall epitome) are further elaborated. Each second level elaboration is followed by a summary leading to an expanded epitome on that elaboration. This elaboration process continues until all aspects of the subject are covered to an adequate level of detail. The primary structure of elaboration theory consists of a series of synthesis-analysis-summary operations (Merrill, Wilson, & Kelety, Note 3). This top-down, general-to-detailed sequence of learning incorporates a fundamental principle from subsumption theory (Ausubel, 1968), progressive differentiation. The general ideas should be presented first and then progressively differentiated (elaborated) in terms of detail and specificity. This is consistent with the way that subsumption, assimilation, and schema theories postulate that information is stored in the learner's cognitive structure. Since elaboration theory is basically expository in nature, it makes no use of the other fundamental tenet of subsumption theory -- integrative reconciliation, i.e., relating new materials to ideas already in the learner's cognitive structure. The theoretical basis for elaboration theory --which is not really a theory, but rather a group of organizing principles for instruction or "elaboration technology" (Mayer, Note 4) -- is in schema theory. The general-to-specific sequencing provides the learner with a schema or framework for assimilating more specific material (Merrill, Wilson, & Kelety, Note 3). The schemata that are formed by the epitomes comprise a network to allow for integrating and relating concepts, an internal integrative reconciliation process. Another important assumption derived from schema theory is that relationships between the concepts which form the structure of the content should be taught explicitly. Elaboration theory seeks to make the content structure, as defined by Reigeluth and Merrill (1979), obvious. The elaboration theory of instruction represents an effort to apply lessons from cognitive psychology in a more comprehensive and systematic way than occurs with the use of advance organizers. A scheme combining elaboration theory and information processing analysis (P. Merrill, 1978) as a task analysis procedure is described by Reigeluth and Rogers (1980). The most obvious implications of elaboration theory for instructional design is in this area.

Although a paucity of empirical verification of the elaboration theory exists, content-treatment interactions similar to those for advance organizers could be inferred based upon the similarity in their theoretical background. Elaborated lessons would be expected to facilitate the learning of conceptually oriented material requiring transfer rather than recall. The structure of recall, representing the way ideas are related to each other would be supplanted by this method of organization. Rule using and discovery learning would also be expected to profit from the elaborated morphology provided by such instruction. To form the interaction we would presume that tasks or materials oriented by the need for recall, near transfer and serial learning probably would be inhibited by elaboration theory. A systematic research effort is needed to verify these predictions and to make the elaboration approach an established instructional strategy.

Component Display Theory

Component display theory (Merrill, Reigeluth & Faust, 1979; Merrill, Richards, Schmidt & Wood, 1977) has evolved over the past decade into a comprehensive theory (or technology) for designing, sequencing and presenting instruction. Expanding on the task analytic hierarchical approach that has dominated the field, component display theory accommodates not only differences in tasks in its designs, but also considers content types. Instructional purposes are refined into objectives which are classified according to task -- remember, recall (verbatim or generality) use, and more recently, find (discover) (Merrill, Kowallis & Wilson, in press) -- as well as content type -- fact, concept, principle, procedure. A set of principles and procedures are prescribed for determining the consistency between educational purpose, objectives, test items, and finally, presentation forms.

According to the component display theory any instructional presentation, regardless of the display medium employed, can be made by either telling or questioning with generalities and instances. These are the primary presentation forms. The sequence in which they are presented is determined by the type of content and the task level represented by the objective and test item. For instance, "for objectives and test items classified at the use-a-generality level, the generality, some instances and some practice are the primary presentation forms needed" (Merrill, Reigeluth & Faust, 1979, p. 184).

These primary presentation forms are embellished by a variety of strategies, such as feedback, isolation, prompts, divergence, and matching. The application of these strategies to each primary presentation form varies by task level and content type. Their appropriate use helps determine the adequacy of any presentation.

This distillation of component display theory cannot do it justice, especially with respect to its comprehensiveness and applicability. As an instructional theory, it is premised on content x task x treatment interactions. The assumption is that instruction should be organized on the basis of the structural properties of the content and the nature of the interaction between content and the intellectual requirements of the learning task. It predicts that a particular combination of presentation forms will optimally produce learning (Merrill, Kowallis & Wilson, in press). A major strength of the theory relates to its consideration of content type in the determination of appropriate designs. Its major weakness relates to its ability to order the display components for instruction of only a single concept, principle, etc. It is currently a micro-instructional theory. Interrelating the variety of content that comprises any lesson is an essential component of any theory of instruction. Such a macro-instructional theory has been promised by the authors. When available, component display theory may well constitute the most elaborate and useful design model available. Before that occurs, however, it will require empirical support. In a series of validation studies conducted in real-world settings (Merrill & Wood, 1977) instructional procedures designed using component display theory did not produce significantly better performance or time-to-completion. However, in a post hoc comparison of competing organic chemistry texts, the book that achieved a higher rating on the basis of component display theory variables produced commensurately better student performance. Since component display theory is premised on such well established principles of instruction, future validation efforts should probably confirm its efficacy as a model of instructional design.

Discovery Learning

The popularity of the discovery approach to learning resulted from the advocacy of Jerome Bruner (1961), although the approach had been considered much earlier. Bruner preferred a classical, scientific method of discovery -- inferring from evidence, gaining insights, allowing students to organize information and later apply it to the solution of learning problems. Ausubel (1963) reconceptualized Bruner's notion of discovery by dichotomizing learning into two classes, discovery and reception. Reception learning, he contended, occurs when all the content is presented to the learner. Discovery learning represents all other instruction and is appropriate only "when the learner is in the concrete stage of logical operations and is dependent on concrete-empirical props" (Ausubel, 1962b). Beyond that stage, expository instruction was considered to be the more effective.

Early instructional designers working in programmed instruction reduced the dichotomy to testable constructs -- RULEG (rule or generality followed by examples) and EGRULE (instances presented to induce rule)(Evans, Homme & Glaser, 1962). The former represents an expository and deductive approach to instruction favored by Ausubel, and the latter, EGRULE, represents an inductive, discovery approach where the learner is required to infer the generalization from the common characteristics represented in the instances.

Despite a number of conceptual (lack of agreement on the meaning of discovery) and methodological problems plaguing discovery learning research, some generally consistent conclusions can be drawn (Herman, 1969). Content-treatment interactions tend to occur with regard to the information processing requirements of the task. RULEG or expository instruction facilitates retention of material whereas EGRULE or discovery methods generally inhibit recall. Remote transfer skills, on the other hand, are facilitated by discovery methods and inhibited by expository (Guthrie, 1967; Worthen, 1968). Some form of intermediate direction (guided discovery) tends to produce superior results regardless of the dependent variable (Gagne & Brown, 1969; Kornreich, 1969).

The results of discovery learning research also provides an heuristic, based on a content-treatment interaction conception, for structuring and sequencing learning. Those tasks that entail application and transfer should require the learner to induce or discover the concept or principle defined by the subject matter. A sequence of instances with appropriate prompts can be presented to the learner so as to insure some success, a necessary ingredient to keep learners on task (Anderson & Faust, 1973). For recall of concepts or principles, an expository or RULEG approach is more efficient, as Ausubel proposed.

Curriculum Development

If all of this discussion of instructional methods sequenced and arranged by the content structure of the subject matter gives you the unsettling feeling of deja vu, it's understandable. You were there -- in the sixties, when curriculum theorists stressed the importance of the structure of the discipline (Bruner, 1960). The same underlying theories regarding organization of knowledge and its reflection in the learning curricula being homeomorphically reconstructed in the knowledge bases of learners is behind most of the approaches presented here. Content structuring from a curriculum point of view, however, does not begin with assumptions about human learning. That is, sequencing is not based upon principles of cognitive processing. Rather, organization of curriculum and materials is mostly based on characteristics of the knowledge being learned, not on characteristics of human learning. The attempt is to represent things the way they are. To this end Posner and Strike (1976) analyzed content structure, dividing them into five major classes, including:

- World-related: the way things exist in the world
- Concept-related: organization of conceptual world into logical structure
- Inquiry-related: logic and methodology of discovery
- Learning-related: processes of human learning, including hierarchical prerequisite, prior learning, difficulty developmental requirements
- Utilization-related: social, personal, or career needs

These classes represent a broad range of organizational perspectives, many of which have been verified by a substantial body of human research. Their applicability in learning context have been tested over a number of years. Their intuitive value in sequencing instruction is doubtless. Since this paper elaborated from instructional design and task analysis, however, a lengthy review of these content-structuring principles would not be appropriate. Suffice it to say they offer the instructional design researchers a large number of plausible alternative hypotheses for sequencing instruction.

Philosophical Analysis

The final justification for a CTI approach to instructional design is philosophical, a consideration traditionally eschewed by researchers concentrating on behavior. If our theories/ models won't stand the test of rationality, though, they should probably be discarded.

Content-treatment interactions are predicated on the structure of ideas represented by subject matter and the resulting structure of knowledge in the memory of the learner exposed to that subject matter. This perspective makes certain assumptions about how the learner acquires knowledge. It takes a constructivistic position, that conceives of man as an organized entity that actively participates in the construction of known reality (Reese & Overton, 1970). This epistemological distinction has generally eluded research in educational technology, with its rigorous application and sequencing of hierarchical patterns of behavior. Constructivism suggests that we have progressed from a closed system of ordering learning tasks and procedures into rigid hierarchies.

The most appropriate psycho-philosophical construct for assuming this new perspective is constructivism. Based largely on the work of Piaget and other structuralists, constructivism suggests that the assimilation of sense data stimulates internal, mental operations that organize that information into schema (a term first used by Kant), constructing knowledge structures. These operations in effect transform realistic sense data into mental constructs. Knowing reality is a process of constructing transformations that [illegible] reality (Piaget, 1970).

The approach to sequencing and synthesizing instruction suggested by content-treatment interactions is inherently constructive. Behavioral analysis, on the other hand, is inherently reductionistic, seeking to break down a constructive process like learning into its most rudimentary components. Polanyi (1958) has argued that the "comprehensive entity" that defines a person cannot derive merely from an analysis of the laws that apply to its behavior. All learning is surely related to knowing, which entails the internalization of ideas and their effects on an individual's personal identity.

The process of knowing, i.e., constructing personal models of reality, is also inherently individualistic. We all make sense out of the world differently. This should not imply that we can or should attempt to restructure and adapt that reality to accommodate the way each individual understands it. If man is an active organism that actively interacts with his environment, he will interpret the experiences resulting from that interaction and subsequently construct his own knowledge in his own way. It is impossible to adapt reality, to break it down and synthesize it into a different form for each learner, as the ATI research paradigm might suggest. Such an approach is atomistic. A more appropriate strategy would require the learner to interact with instructional materials and sequences to reconstruct or "re-present" it to his own knowledge structure (Sigel, Note 5). While cognitive psychology does not preclude the role of individual differences and by inference ATI, it is more theoretically premised on the construction of knowledge rather than the analysis, reduction, and adaptation of it.

Conclusion

As Olson (1976) concluded, we're a long way from a comprehensive theory of instruction necessary for adequately conceptualizing cognitive processes. Aptitude-treatment interaction techniques remain a valid research model that can, as Snow (1980) suggests, contribute to our understanding of these processes. However, they possess limited applicability as an operationalized design model (see Parkhurst + McCombs, 1979) or a curriculum design model such as matching (see Messick, 1976). Designers would profit more from concentrating on the structural properties of subject matter and the information processing requirements of the task of assimilating those properties. By analyzing the interactions between treatment and content structure, designers are also contributing to the derivation of theories of instruction as well as producing "idealized" treatments that will lead most efficiently to learning. Summarily stated, instruction derived from cognition is content-specific.

Content-treatment interactions, as developed in this paper, do not constitute a model of instructional design or instructional research, but rather provide an heuristic for researchers and designers. Just as ATI was not conceived as a theoretical rationale for educational research, neither is CTI. The structural properties of content and cognition that form the basis for CTI do represent the best theoretical foundation for research that we have available. They can serve instructional design likewise. The attempt to accommodate individual differences identified by ATI research in instructional designs is a noble idea, albeit an impractical one. A CTI approach to design is inherently more

- practical
- cost effective (another issue worthy of elaboration)
- consistent with theories of knowledge acquisition
- productive in terms of curriculum/product development

Content analysis is a process only alluded to in many instructional design models and completely neglected in others. It is a design competency that is not accorded much importance in the new DID list of competency statements (see Instructional Innovator, December, 1980) or by practitioners. How successfully are practitioners taught to "analyze structural characteristics of a job, task, and/or content"? If they have been, how is such analysis normally transferred to practice? Content analysis is an essential process in instructional design that can be facilitated by a content-treatment interaction approach.

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Personality and Cognitive Style Predictors of Teaching Style Preferences

An Exploratory Study

David H. Jonassen

University of North Carolina at Greensboro

Paper presented at the Association for Educational Communication and Technology Convention, Philadelphia, Pennsylvania, April 9, 1981

Running Head: Personality/Cognitive Style Predictors

Request for Reprints may be addressed to:
David H. Jonassen
School of Education
University of North Carolina
Greensboro, North Carolina 27412

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Abstract

Previous research has found that students with learning styles similar to instructors' learning and teaching styles perform better. This study investigated the effects of personality and cognitive style preferences on preferred teaching styles. Pre-service teachers completed the Myers-Briggs Type Indicator, the Educational Cognitive Style Inventory, and the Learning Styles Inventory. Personality types, especially thinking/feeling, significantly predicted the importance of instructor/student affiliation and content preferred by the teachers. Strong predictive relationships between cognitive styles and teaching styles also were found, indicating that determinants of preferred teaching styles include individual instructor's learning styles.

Cognitive Styles and Teaching Styles

Teachers exert a profound influence on the development of learning styles in their students. They control not only the content of student learning, but also the method of presentation, type of structuring, and preferences for thought processes. For instance, Heller (1980) found that teachers with cognitive preferences for memory and application produced similar cognitive effects in students. This study focuses on what predisposes teachers towards various preferences. That information may allow us to predict teaching effectiveness or to more beneficially assign teachers to appropriate teaching situations, since teachers perform better in teaching situations that are compatible with their teaching style (Kirby, 1979; Wyett, 1967).

Since students who have learning styles more closely related to the instructor's teaching style perform better (Raines, 1976; Witkin, et al, 1977), learning styles or cognitive styles of teachers should be related to their ultimate teaching styles. "Knowing your cognitive or learning style will help one accommodate their style to those in the class or to accommodate their's to one's own. This information should be most critical during the time of professional training to prepare for a career" (Kirby, 1979, p. 89). While several studies have linked specific cognitive styles to performances, (Jonassen, 1980), only one has found a connection between an individual's cognitive style and his/her teaching style. Knowing one's cognitive styles may help prospective teachers to develop or accordingly adapt their teaching styles. Changes in teaching style can be accomplished. Such changes, however, are based on self-concept (Niederwerfer, 1975), which determines if changes will be accepted.

A further rationale for assessing the relationship between cognitive styles and teaching styles is suggested by the matching model of instruction. This model seeks to match students learner characteristics with teachers possessing consonant teaching styles (Messick, 1976). While a large body of literature supports the validity of such an approach, results to date have been inconsistent. Matching students and teachers based on similarities in their cognitive and teaching styles produced increases in educational development and reading level, with "matched" students expressing a more positive attitude about their instructional activities than unmatched students (McAdam, 1971). In a community college study, Frever (1975) successfully matched students with educational activities, resulting in higher course grades. On the other hand, Scerba's matching of learning styles with teaching styles produced no differences on any measure of student performance (1979). Considering the difficulty and expense of matching students with teachers or preferred instructional activities, he strongly rejected matching procedures. In support of this conclusion, Hunter (1980) found no relationship between student/teacher differences in preferred learning/teaching styles and students grades or ratings of the instructor. The lack of success in matching may be due to environmental variables that prevent instructors from manifesting their preferred learning styles in their teaching. Do teachers follow the maxim, "teachers teach as they were taught," or do they manifest their preferred modes for assimiliating information, i.e. "teachers teach as they learned "? We need to ask what other antecedents of teaching style may exist, if cognitive styles don't exert a deciding influence.

Personality

Behavior varies between individuals. Such variations, according to Jungian Theory, are not chance or random, rather they are the result of differences in mental functioning. Individuals vary in their basic perceptive process, i.e. how they become aware of things, ideas, events. They also vary in their judging processes, i.e. how they draw conclusions about what they have perceived. Individuals may perceive by sensing or intuition and judge by thinking or feeling. These differences further indicate a tendency for introversion or extraversion. These differences are referred to as personality types, and are measured by the Myers-Briggs Type Indicator (Myers, 1970). Four dichotomous dimensions, consistent with Jungian Theory, are measured by this instrument:

Extraversion	Introversion
relates to the outer world of people and things, acting more readily	relates to own inner world of ideas, reflecting on them before acting
Sensing	Intuition
perceiving reality through the senses, dealing with practical elements of reality, revealing facts	internal sensing using imagination, preferring possibilities and problems to facts
Thinking	Feeling
analytical, logical, evaluative modes of thought	sympathy, empathy, and emphasis on personal values
Judging	Perceptive
Emphasizes thinking or feeling, seeking an orderly, controlled existence	Sensing or intuitive, living flexible, spontaneous, adaptive existence

The thinking and feeling types Jung refered to as rational functions. An individuals's productivity for these mental operations is indicated by their tendency to be judging types. Sensing and intuition are perceptive in nature (as measured by the MBTI), functions which Jung refered to as irrational. Sixteen individual types have been identified from combinations of the four dimensions, indicating large variations in the way individuals relate to each other and their environment.

Personality/Cognitive Style Predictors

Personality and Achievement

Personality type indicators have been related to several aspects of the educational process. Several attempts to relate personality types to academic achievement have failed to produce definitive results. Based upon a review of the literature and the results of their own study employing over 1800 students, Hengstler et al (1980) concluded that there is a low to moderate relationship between academic success and scores on the MBTI. Low correlations between intuition and success were confirmed with even weaker, albeit significant, correlations between the judging-perceptive dimension and GPA in college students. The amount of variance in grades accounted by any of the personality dimensions was less than two percent. These results are not surprising since the personality types measured by the MBTI indicate non-intellectual preferences for how individual perceive information and draw conclusions from it.

Personality and Learning

Since personality does not seem to be related to learning results, perhaps it can be more productively employed to predict how individuals will go about assimilating knowledge from their environments. Tentative relationships between instructor ratings, as reflective of a style of teaching, were found by Blank (1970). Students with personality types consistent with the instructor rated the instructor higher in interest involvement, and student-teacher interaction, even though the instructor's types were not ever consonant with those types (INTJ). The judging-perceptive and sensing-intuition dimensions are the best predictors of teacher evaluations (Taylor, 1969). These results are congruent with the learning style-teaching style results. Learning is easier from an instructor whose perception/conception of reality is similar to yours.

Personality and Teaching Styles

The most positive contributions of personality theory to the educational process may result from using typologies to predict the quality and style of teaching among pre-service teachers, possibly as a screening device. Since "instructor's personality" is the most important evaluative dimension to students (Roberts, 1977), using type indicators to assess individuals' potentials for teaching success may prove valuable.

What are teachers' personalities like? Most tend to be feeling types, as opposed to thinking types. At lower educational levels they tend to be sensing/feeling types — sociable and friendly. At higher levels (high school and college), teachers tend to be intuitive types (Carlyn, 1976; McCaully, 1974). It is reasonable to assume that sensing and judging types prefer to teach and learn in an orderly, systematic manner. They respond well to multi-media instruction but do not respond well to individual reading/listening. On the other hand, intuitive and perceptive types prefer to teach and learn in flexible, unstructured ways, prefering use of the written and spoken word (Roberts, 1977). Using personality types to predict more specific strategy preferences, Carlyn (1976) found that intuitive teachers have a stronger need for creativity and independence and are generally more interested in working with small groups than sensing types. Extraverted/thinking types prefer administrative functions, while extraverted/intuitive types prefer school planning functions. Teaching strategies were related to personality types by Rudisill (1973), who found that extraverts preferred self-pacing and laboratory techniques. Perceptive teachers prefered using questioning techniques. While these results are isolated and inconclusive they do suggest that teaching strategies vary considerably according to the personality of the teacher. Considerally more research will be necessary to generate sufficient consistency to make personality a useful predictor of teaching styles or potential success as a teacher in different settings.

Purpose of the Study

This study was designed to investigate the following questions:

1. Are cognitive style preferences significant predictors of teaching style preferences?
2. Are personality variables significant predictors of teaching style preferences?
3. Which contributes more to variance in teaching style preference scores, cognitive styles or personality?
4. Are there significant correlations between cognitive style preferences and personality variables?

METHOD

Sample

A total of 93 upper-level undergraduate, secondary teacher-education students enrolled in three sections of an educational psychology course at the University of North Carolina at Greensboro formed the sample for this study. These students represented a variety of cognate majors from throughout the university. Seventy percent of the sample was female; thirty percent was male. These students were all preservice teachers, enrolled in their student teaching semester.

Instrumentation

Under the auspices of the Institutional Research Department of the university, students were administered the Myers-Briggs Personality Type Indicator (MBTI). This instrument consists of 166 forced-choice questions, producting eight subtotal scores on four bipolar dimensions: introversion-extraversion; sensing-intuition; thinking-feeling; judging-perceptive. Based upon Jung's Theory of Type, the MBTI measures non-intellective preference strengths (0-7) for the eight scores listed above. These scores reflect the kinds of judgements and perceptions an individual uses in interacting with their environment, (Meyers, 1970). The eight dichotomous scores were combined to produce four continuous variables for data analysis. Preference scores were converted to continuous scores by using a score of seventy as the midpoint on each dimension and adding/subtracting the differences from the larger preference strengths (Hengstler, in press).

At a later point in the semester, students were administered two self-report instruments that reflected their preferred modes for seeking information (cognitive style) and for teaching (styles). The Educational Cognitive Style Inventory is part of a test battery developed at Oakland Community College (Michigan) to determine the educational cognitive style of individuals. As a part of the Educational Sciences (Hill, 1974), this instrument seeks to empirically map an individual's mode of behavior in searching for meaning. An individual's educational cognitive style is comprised of the Cartesian product of sets of information: symbols and their meaning, cultural determinants of the meaning of symbols, modalities of inference, and educational memory. The first three of these are measured by the Cognitive Style Interest Inventory; the last remains in the developmental stage.

Twenty-eight variables, each consisting of eight items in the inventory, are measured. These are forced-choice responses (rarely, sometimes or usually) to questions related to each style measured. Each response is weighted and summed for each variable. The ordering of questions is randomized to minimize response set.

Insert TABLE 1 about here.

Personality/Cognitive Style Predictors

Teaching style preferences were measured by the Instructional Styles Inventory (Canfield & Canfield, 1976), which consists of 25 items containing four response options. Individuals rank each option (1-4) consonant with their preferences for teaching. Two were eliminated because of their redundancy, which produces 20 variable scores on four dimensions (Table 2). Eight condition variables relate the degree of emphasis the teachers believe they should have in the teaching/learning relationship. Four content variables indicate the instructor's interest in different types of instructional content. Four mode variables relate to preferred teaching modality. The four responsibility variables indicate the instructor's willingness to assume responsibility for student learning. The ranks for each question are summed to produce a total score for each variable. The smaller the score the greater the preference is indicated for that teaching style, i.e. the higher is the ranking.

Insert TABLE 2 about here.

RESULTS

Pearson product moment correlation coefficients between the MBTI and Instructional Styles Inventory (ISI) were calculated and are presented in Table 3. In addition, stepwise regression analyses, using the .50 significanse level as the entry criterion and .05 level for retention were conducted for each of the teaching style variables, with the MBTI Scores serving as independent variables (Table 4). Both of these analyses confirm that the thinking/feeling dimension is the most related to and significant predictor of teaching style preference. Feelers tend to regard peer and instructor affiliation as more important styles. Negative values, it should be noted, are positively correlated with the values on the ISI, since a smaller value indicates a stronger preference. Feelers as opposed to

Insert Tables 3 and 4 about here

thinkers, show significant relationships to qualitative content such as writing and working with people. On the other hand, feeling is negatively related to the use of numerics and inanimate content (constructive activities). The judging/perceptive type indicator was a significant predictor of preference for numerics (judgers) and working with people (feelers). The sensing/intuition dimension was entered only for the qualitative variable, intuition being positively related to qualitative content.

To assess the relationship of cognitive styles to teaching style preferences, Pearson correlation coefficients between the CSI and ISI were calculated (Table 5), as well as stepwise regression analyses (Table 6). As few as one cogniitive style variable were entered accounting for as little as 10% of the variance. As many as eight variables were found to be significant predictors of specific teaching styles, accounting for as much as two thirds of the variance of instructor affiliation scores. The most frequently entered cognitive style variables were not modality variables as might be expected, but rather those related to esthetics, kinesics (non-verbal communication), and synnoetics (self-knowledge).

A detailed review of each variable and its assorted cognitive style predictors would be tedious. Of interest to designers are the teaching mode variables. Lecturing is preferred by those low in communicative ability (kinesics and synnoetics) but more skilled in motor performance (kinesthetics) and categorical reasoning (magnitude). Preference for the use of reading as a primary instructional mode is understandably predicted by theoretical auditory linguistics (listening to words) and the qualitative visual codes. Iconics, the preference for visualizing instruction, generated three significant predictors. Teachers who prefer categorical reasoning (magnitude) and who are adept at learning digital information (theoretical visual quantitative) show a negative preferenc for the use of Iconics. Non-verbal communication (kinesics) is a strong positive predictor of preference for visual instruction. The final instructional modality, direct experience, interacted significantly with qualitative codes tactile, synnoetics, and the comparison-contrast mode of reasoning. The responsibility varaibles had not significant predictors.

Insert Tables 5 and 6 about here.

DISCUSSION

From an analysis of the results, it can be concluded that personality varaibles, specifically Jungian type indicators, are useful for predicting only a limited range of teaching style preferences. Those styles related only to personal affiliation, that is, to what extent the student needs to affiliate with the teacher and peers, and **to** content preferences (choice of subject matter speciality). These variables represent only two dimensions of the variables measured by the Learning Styles Inventory. Feelers, as opposed to thinkers, genrally reagrded affiiation as a more important component in the instructional process. This is consistent with Myers (1970) description of feelers, who emphasize personal relationships, while thinkers are more absorbed in internal, abstract modes of thought.

The other group of teaching styles that significantly interact with personality are the four content variables. Again, consistent with Jungian theory, thinkers prefer numeric and inanimate instructional content, while feelers prefer qualitative and people-oriented content. In addition to the thinking/feeling dimension, the overall judging/perceptive type dimension was found to be a consistent predictor of preference for two of the content types. Judgers, who are systematic and internal types, prefer numeric instruction while perceivers, more flexible and spontaneous in their existence, prefer people-related instruction. Qualitative instruction (language related) is preferred by extraverted intuiters, individuals who interact with the outside world but depend upon their imagination to conceptualize it, ie. a writer.

Personality types, it appears, can be useful in very limited ways for preservice or inservice teacher preparation. They can provide teacher educators with some indication of a person's preferred field of teaching, viz. the degree of satisfaction teachers may derive. As such, personality types indicators would be most useful in the prescreeing/advising process for admission into certain tracks and not as part of the teacher education process itself. The results related to peer/instructor affiliation would be of little value for designers, except as an indicator of preference for group oriented or tutorial modes of instruction. Without more information about instructional conditions, personality variables are of little value in the training of teachers.

Cognitive style preferences, however, provide clearer pictures about how an individual wil go about teaching. The ways in which we prefer to learn appear to influence the ways in which we choose to teach, which is consistent with findings related to cognitive styles (Witkin, et al, 1977). For all but three teaching style preferences, organization (an intellective process not measured by the CSI) and the responsibility variables, cognitive style preferences were significant predictors. For determination of preferred instructional mode, a variety of significant predictors emerged. From those results we can conclude that teachers who prefer to lecture are not necessarily natural communicators. They tend to be more physically oriented and like to reason by rule or policy. Lecturing is simply the accepted presentation mode. Those teachers who prefer to assign readings tend to prefer to read themselves. Those who prefer to visualize their instruction do not learn well from listening. In fact, they prefer to learn through non-verbal means. Visualizers avoid categorical, rule-oriented modes of thought, opting for a more holistic approach to instruction, a finding that is consistent with the brain hemisphericity experiments recently popularized. Those teachers who prefer direct experiences, such as laboratories or simulations, are more tactile and have a better understanding of themselves. They prefer involvement.

Most teaching styles have as their antecedents the individual instructor's learning styles. Generally the qualitative codes for assimilating information, as opposed to the theoretical, were found to be the best predictors for most teaching styles. These results indicate that individuals' preferred modes for learning, which are usually culturally and experientially mediated, affect perceptions and preferences for the way information should be presented.

The factors that affect utilization of mediated forms of learning are more multi-farious than suggested by traditional inter-media comparison research. Since teachers normally exert the greatest amount of control over the learning process, understanding the factors that predispose them toward different methodologies may help us predict the effectiveness of media dissemination projects, as well as to suggest some approaches to media skills development and teacher training or teacher placement in instructional situations.

It should be noted that the conclusions reported here require some degree of inference, due largely to the use of self-report inventories as the only source of data. Personality and preference indicators, such as those employed in this study, are subject to a number of potential deficiciencies. Three major problem areas - typology, effect on taker, and response set - are reviewed by Brown (1970). The first problem is semantic and statistic - determining what is measured by any self-report instrument. The meaning implied by any test and interpreted by test takers is normally inferred from statistical techniques, viz. factor analysis.

Typology is based on commonality of variance, not interpretation of meaning. This multi -trait, statistical approach always calls into question the meaning we ascribe to any instrument. The second problem is a Heisenberg Uncertainty situation - can we localize and measure personality traits without any effect on the personality caused by such a dose of introspection and self-evaluation. Finally, to what extent do test-takers idealize or falsify their responses to project an inaccurate image of their own attitudes. These and other factors render the results obtained from any study employing self-report instruments less than absolute.

It should also be pointed out that the three instruments employed in this study have a considerable amount of empirical, validation support, especially the MBTI. The weakest of the three is the CSI, largely because of a predilection of the author, Hill (a statistician) against extensive analysis. The fact that all of the results occurred in predicted or readily explicable directions supports the conclusions drwan from the study. Personality types have limited applicability in predicting preferred teaching styles, while learning styles show more extensive correlative and predictive relationships.

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TABLE 1

Educational Cognitive Style Variables

SYMBOLS AND THEIR MEANINGS

Theoretical Orientation to Symbols:

1.	T(AL)	Theoretical Auditory Linguistics. Finding meaning through words you hear.
2.	T(AQ)	Theoretical Auditory Quantitative. Finding meaning in spoken numerical symbols, relationships, and measurements.
3.	T(VL)	Theoretical Visual Linguistics. Finding meaning from words you see.
4.	T(VQ)	Theoretical Visual Quantitative. Finding meaning in numerical symbols, relationships, and measurements you see.

Qualitative Orientation to Symbols:

5.	Q(A)	Qualitative Auditory. Perceiving meaning through the sense of hearing. A major in this area indicates ability to distinguish between sounds, tones of music, and other purely sonic sensations.
6.	Q(O)	Qualitative Olfactory. Perceiving meaning through the sense of smell.
7.	Q(S)	Qualitative Savory. Perceiving meaning by the sense of taste. Chefs should have highly developed qualitative olfactory and savory abilities.
8.	Q(T)	Qualitative Tactile. Perceiving meaning by the sense of touch, temperature, and pain.
9.	Q(V)	Qualitative Visual. Perceiving meaning through sight.
10.	Q(P)	Qualitative Code Proprioceptive or sometimes called the sixth sense, synthesizing or combining a number of associated symbols into a performance of a task; e.g., typewriting, playing a musical instrument.
11.	Q(CEM)	Qualitative Code Empathetic. Sensitivity to the feelings of others, ability to put yourself in another person's place and see things from his point of view.
12.	Q(CES)	Qualitative Code Esthetic. Enjoying the beauty of an object or an idea. Beauty in surroundings or a well-turned phrase are appreciated by a person possessing a major strength in this area.

13. Q(CET) *Qualitative Code Ethic*. Commitment to a set of values, a group of principles, obligations and/or duties. This commitment need not imply morality. Both a priest and a criminal may be committed to a set of values although the "values" may be decidedly different.

14. Q(CH) *Qualitative Code Histrionic*. Exhibiting a deliberate behavior or "playing a role: to produce some particular effect on other persons. This type of person knows how to fulfill role expectations.

15. Q(CK) *Qualitative Code Kinesics*. Understanding and communicating by non-linguistic functions such as facial expressions and motions of the body (e.g., smiles and gestures).

16. Q(CKH) *Qualitative Code Kinesthetic*. Performing motor skills according to a recommended, or acceptable, from (e.g., bowling according to form, or golfing).

17. Q(CP) *Qualitative Code Proxemics*. Judging the physical and social distance that the other person would permit, between oneself and that other person.

18. Q(CS) *Qualitative Code Synnoetics*. Personal knowledge of oneself.

19. Q(CT) *Qualitative Code Transactional*. Maintaining a positive communicative interaction which significantly influences the goals of the persons involved in that interaction (e.g., salesmanship).

20. Q(CTM) *Qualitative Code Temporal*. Responding or behaving according to time expectations imposed on an activity by members in the role-set associated with that activity.

CULTURAL DETERMINANTS OF THE MEANINGS OF SYMBOLS

21. A Represents *Associates*. A major degree of influence by friends or persons other than family.

22. F Indicates a major *Family* influence. The family influence might include immediate family, church or special authority figures.

23. I Stands for *Individual*. An "I" in the major column indicates significant independence in decision making.

MODALITIES OF INFERENCE

24. M *Magnitude*. A form of "categorical reasoning" that utilizes classifications or rules as the basis for accepting or rejecting an advanced hypothesis. Persons who need to define things or know the "policy" in order to understand them reflect this modality.

Personality/Cognitive Style Predictors

25. D Difference. This pattern suggests a tendency to reason in terms of one-to-one contrasts and comparisons of selected characteristics or measurements, seeing things in terms of how they "differ". Artists often possess this modality as do creative writers and musicians.

26. R Relationship. This modality requires that things be seen in terms of how they are alike. People with this modality frequently say, "This is like that."

27. L Appraisal. The modality of inference employed by an individual who uses all three of the modalities noted above (M,D, an R), giving equal weight to each in his reasoning process. Individuals who employ this modality tend to analyze, question, or in effect, appraise that which is under consideration in the process of drawing a probability conclusion.

28. D Deductive. Indicates deductive reasoning, or the form of logical proof used in geometry or that employed in syllogistic reasoning.

TABLE 2

DESCRIPTION OF INSTRUCTION STYLES INVENTORY VARIABLES

(Canfield & Lafferty, 1975)

CONDITIONS

Scores on these eight scales indicate the relative emphasis an instructor prefers in the teaching/learning relationship.

Peer Affiliation: Having students work in teams; encouraging good relations among students; having students become friends.

Organization: Organizing course work logically and clearly; giving meaningful assignments and sequence of instructional activities.

Goal Setting: Letting students set their own objectives; providing feedback to help them modify goals and procedures; letting students make their own decisions on objectives.

Competition: Creating situations where students are compared with one another; getting students to compete among themselves.

Instructor Affiliation: Encouraging the students to know the instructor personally; developing a mutual understanding; liking one another.

Detail: Providing specific information on assignments, rules, requirements, etc.

Independence: Encouraging students to work alone and independently; letting them plan for themselves.

CONTENT

These scales indicate an instructor's comparative levels of interest in four areas.

Numeric: Working with numbers and logic; computing; solving mathematical problems, etc.

Qualitative: Working with words or language; writing; editing; talking.

Inanimate: Working with things; building; repairing; designing; operating.

People: Working with people; interviewing; counselling; selling; helping.

MODE

Scores reflect the person's preferences for particular instructional procedures.

Lecturing: Giving information by lectures, tapes, speeches, etc.

Readings: Providing written words as in reading texts, pamphlets, etc.

Iconics: Showing illustrations such as movies, slides, pictures, graphs, etc.

Direct Experience: Getting students to handle or perform; laboratory, shop, field trips, practice exercises.

(cont.)

RESPONSIBILITY

The comparative amounts of responsibility that an instructor feels he has, or will accept for the learning process.

I: Instructor takes primary or major responsibility for student learning

S: Primary or total responsibility for learning on the student.

TABLE 3

INTERCORRELATION BETWEEN MBTI AND ISI

(Pearson Product Monet Coefficients)

	Introversion/ Extraversion	Sensing/ Intuition	Thinking/ Feeling	Judging/ Perceptive
Peer Affiliation	-.020	.037	-.274*	.011
Organization	.199	-.196	.091	-.060
Goal Setting	-.109	-.049	.022	-.130
Competition	-.120	.218	.163	.205
Instructor Affiliation	.103	.017	-.415**	-.112
Detail	-.129	.016	.061	.165
Independence	-.074	-.065	.145	-.118
Authority	.123	-.058	.203	.080
Numerics	.070	.249	.283*	.350**
Qualitative	-.151	-.282*	-.332*	.003
Inanimate	-.081	.138	.364**	.103
People	.131	-.181	-.346**	.297*
Lecture	.168	-.188	.160	.070
Readings	-.172	.029	.018	.141
Iconics	-.014	.017	-.204	-.138
Direct Experience	-.014	.085	.001	.009
Instructor Responsibility	-.200	.076	-.051	-.063
Student Responsibility	-.027	.092	.100	.135

* $p < .05$
** $p < .01$

TABLE 4

SUMMARY OF STEPWISE REGRESSION ANALYSES

INDICATING SIGNIFICANT PERSONALITY PREDICTORS

Dependent Variable	Intercept	Independent Variables	b Value	Type 1/SS	F	R^2
Peer Affiliation	20.11	Thinking/Feeling	-0.090	37.05	4.32*	.075
Instructor Affiliation	20.41	Thinking/Feeling	-0.126	71.43	11.05**	.173
Numerics	0.78	Thinking/Feeling	+0.108	53.17	4.42*	
		Judging/Perceptive	+0.095	86.20	7.17**	.191
Qualitative	27.806	Introversion/Extraversion	-.0049	25.36	3.45	
		Sensing/Intuition	-0.059	31.58	4.30*	
		Thinking/Feeling	-0.124	64.91	8.84**	.233
Inanimate	4.026	Thinking/Feeling	+0.123	68.99	8.08**	.132
People	24.691	Thinking/Feeling	-0.126	71.39	7.00*	
		Judging/Perceptive	-0.072	50.40	4.94*	.120

* $p < .05$

** $p < .01$

TABLE 5

INTERCORRELATIONS BETWEEN CSI AND ISI

(Pearson Product Monet Coefficients)

	Peer Affiliation	Organization	Goal Setting	Competition	Instructor Affiliation	Detail	Independance	Authority	Numeric	Qualitative	Inanimate	People	Lecturing	Readings	Iconics	Direct Experience	Instructor Respons-ibility	Student Responsibility
(AL)	-.022	.188	-.278	.133	-.084	.090	-.135	.186	.110	.043	.050	-.241	-.036	-.284	.233	.038	-.061	.1
(AQ)	.251	.035	-.067	-.163	.013	-.143	.118	-.017	-.477**	.213	.203	.128	-.133	-.018	.324*	-.093	-.051	.0
(VL)	.251	-.199	-.116	.099	.044	.109	.036	-.203	-.081	-.037	-.034	.156	-.061	.001	-.024	.074	.121	-.2
(VQ)	.099	-.016	.026	-.097	-.011	-.062	.131	-.121	-.308*	.179	.191	.004	.032	-.001	.225	-.096	.004	-.2
(A)	.243	.017	.072	-.261	-.100	-.021	.279	-.227	-.115	.388**	-.166	-.081	-.017	.256	-.021	-.133	-.272	.0
(O)	.150	-.054	-.056	.023	.007	-.040	-.001	.058	-.110	-.170	.192	-.075	-.116	.987	.134	-.114	.062	.1
(S)	.199	-.002	-.221	.087	.157	.195	-.208	-.072	.235	-.121	-.028	-.185	.046	.260	.037	-.158	.099	.2
(T)	.364*	-.023	-.180	-.082	.283	.140	-.248	.072	.062	.234	-.193	-.113	.213	.228	-.051	-.345*	.000	-.1
(V)	-.127	.153	-.164	.109	-.077	-.101	-.022	.260	.166	.040	-.021	-.235	.256	.190	-.197	-.305*	-.068	.0
(P)	-.091	-.256	.252	.107	-.151	-.101	.282	-.106	-.122	.231	-.079	-.013	-.158	.063	.218	-.051	-.065	.1
CEM)	.104	-.101	-.045	.051	-.208	.068	-.012	.159	.095	.092	-.028	-.200	.177	-.103	-.133	.007	-.249	.2
CES)	-.041	-.077	-.237	.386**	.016	.172	-.285	.236	.206	-.221	.005	-.133	.042	-,031	-.149	.043	-.194	-.0
CET)	-.063	-.166	.265	-.118	-.262	-.052	.294	-.042	-.159	.247	-.070	.108	-.192	-.008	.068	.122	.052	.0
(CN)	.269	-.276	.148	-.132	.224	-.271	.117	-.118	.084	-.138	.092	.079	-.144	.127	.108	.000	,017	.1
(CK)	-.070	.098	-.100	.034	-.030	.036	-.051	.088	.272	-.221	.091	-.283	.270	.026	-.274	-.135	.138	-.1
KH)	.221	-.240	.193	-.157	.062	-.190	.192	-.106	-.253	.240	-.042	.109	-.255	.178	.082	.020	-.204	.1
(CP)	.130	-.217	.065	.087	.061	.238	-.008	-.261	-.158	.013	-.097	-.150	-.145	.046	.124	.031	-.211	-.0
(CS)	.110	-.190	.216	-.191	.102	-.178	.327*	-.325*	-.255	.152	-.043	.184	.073	.156	.245	-.297*	.084	.09
(CT)	-.106	-.143	.228	-.003	-.182	.013	.246	-.180	-.170	-.056	.301**	-.072	-.146	.172	.129	-.099	-.096	.1
CTM)	.006	.051	.155	-.280	-.088	.137	.122	-.179	-.107	-.214	-.009	-.103	-.019	-.015	.172	-.064	-.079	-.0
	-.179	.221	.016	-.074	-.433	.086	.122	.193	.262	.002	-.031	-.296*	-.004	-.186	.009	-.051	-.252	.1
	-.093	.254	-.234	.107	-.204	.253	-.085	.103	.138	.009	,076	-.255	-.089	.120	-.038	-.196	.147	-.1
	.375*	-.132	-.160	-.056	.442**	.083	-.122	-.348*	-.158	.051	.050	.033	-.071	.111	.028	.035	-.105	.0
	-.213	.259	.069	-.187	.024	.121	.174	-.075	-.217	.164	.128	-.031	-.148	-.090	,247	.037	.037	-.1
	.104	.109	-.243	.114	.146	.166	-.062	.211	-.040	.333*	-.223	-.049	-.229	-.106	.156	.167	.156	-.1
	.336*	-.232	-.088	.017	.085	.154	-.091	.081	-.110	.017	.139	-.065	-.041	.192	.113	-.171	-.118	.0
	-.034	.108	-.089	.039	-.001	.172	-.072	-.085	-.038	.018	.158	-.163	-.252	.075	.007	.169	.006	-.2
	.155	-.232	.123	-.020	.040	-.172	.132	-.035	-.569**	.042	.383*	.251	-.195	.242	.137	-.056	.218	-.0

TABLE 6

SUMMARY OF STEPWISE REGRESSION ANALYSES

INDICATING SIGNIFICANT* PREDICTORS

Dependent Variable	Intercept	Independent Variable	b Value	Type II SS	F	R^2
Peer Affiliation	1.720	Qualitative Tactile	+.226	31.34	5.83	
		Individual	+.200	35.77	6.35	.264
Goal Setting	19.253	Theoretic Auditory Linguistic	-.266	41.73	.684	
		Qualitative	+.310	70.02	11.65	
		Qualitative Esthetic	-.199	42.31	7.04	
		Qualitative Ethic	+.247	39.60	6.59	.385
Competition	13.357	Qualitative Auditory	-.161	25.76	5.03	
		Qualitative Esthetic	+.206	+7.15	9.21	.245
Instructor Affiliation	19.33	Theoretic Visual Linguistic	-.227	36.77	12.60	
		Qualitative Empathetic	-.221	31.39	10.76	
		Qualitative Kenesics	+.243	34.35	11.78	
		Qualitative Transactional	-.181	21.01	7.20	
		Affiliate	-.168	12.93	4.43	
		Instructional	+.245	28.18	9.66	
		Magnitude	-.309	58.89	20.18	
		Difference	+.252	30.82	10.56	.632
Detail	10.20	Qualitative Histrionic	-.213	38.62	6.53	
		Qualitative Proxemics	+.245	33.86	5.73	.187
Independence	6.50	Theoretical Auditory Linguistic	-.272	40.42	4.24	
		Qualitative Esthetic	-.197	42.73	4.49	
		Qualitative Synnoetik	+.336	85.91	9.02	
		Affiliates	+.308	66.61	6.99	.311
Authority	31.88	Qualitative Esthetic	+.229	46.87	11.2	
		Qualitative Proxemics	-.316	52.83	12.65	

		Qualitative Synnoetics	-.269	40.82	9.77	
		Appraisal	-.178	19.50	4.67	.408
Numerics	20.01	Theoretic Auditory Qualitative	-.195	42.31	5.66	
		Qualitative Kinesics	+.276	47.14	6.31	
		Magnitude	-.284	60.68	8.12	
		Deductive	-.295	91.45	12.24	.533
Qualitative	6.37	Qualitative Auditory	+.274	70.93	11.37	
		Qualitative Kinesics	-.293	59.86	9.59	.275
Inanimate	7.90	Deductive	.214	60.87	7.06	.147
People	16.04	Affiliate	-.216	46.34	4.53	.099
Lecturing	11.13	Qualitative Kinesics	+.308	66.80	9.36	
		Qualitative Kinesthetic	-.188	54.98	7.70	
		Qualitative Synnoetics	+.208	30.56	4.28	
		Magnitude	-.267	51.32	7.19	.316
Reading	8.537	Theoretic Auditory Linguistic	-.241	35.51	10.43	
		Qualitative Visual	+.142	19.00	5.58	.214
Iconics	8.025	Theoretical Quditory Quantitave	+.089	11.10	3.83	
		Qualitative Kinesics	-.232	36.99	12.75	
		Magnitude	+.186	26.01	8.97	.324
Direct Experience	27.644	Qualitative Tactile	-.370	77.63	9.90	
		Qualitative Synnoetics	-.247	52.24	6.65	
		Difference	+.295	45.97	5.86	.332

* F Values < 7.10 significant P < .05
F Values > 7.10 significant P < .01

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Sally Jorgensen
A Conceptual Paper
Research and Theory Division
AECT April, 1981

A CALL FOR A TRUCE BETWEEN EDUCATIONAL TECHNOLOGY AND TEACHING:

SUGGESTIONS FOR MUTUALLY BENEFICIAL COLLABORATIONS

IR009568

Sally Jorgensen
Conceptual Paper
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ABSTRACT

"A Call for a Truce between Educational Technology and Teaching: Suggestions for Mutually Beneficial Collaborations"

The following paper provides a conceptual frame for ways in which the fields of educational technology and teaching can and do interrelate with each other. Three types of relationships or, loosely speaking, "models," will be described. They call for educational technology 1) to assume a more open and *attentive posture* toward teachers, teaching, and classroom communication processes in order to stimulate ecologically valid research efforts in ed. tech.; 2) to continue to seek ways to play a *directive, or instructional role* in teacher education, especially in advancing systems approaches to instructional problem-solving; and 3) to engage in *collaborative ventures* in inquiry and development with teachers, teacher trainers and researchers. All three relationships are predicated upon the need for a more cooperative paradigm between the two fields, which seem to exhibit more competition and condescension than cooperation and collaboration. Ideological and praxeological differences between ed. tech. and teaching will be examined, as will disparaties between the ways the two fields perceive each other.

Sally Jorgensen

A CALL FOR A TRUCE BETWEEN EDUCATIONAL TECHNOLOGY AND TEACHING: SUGGESTIONS FOR MUTUALLY BENEFICIAL COLLABORATIONS

The following paper presents an organizing frame for thinking about the relationship between the domains of teaching and educational technology (ET), especially the subsets of inquiry and instructional development (ID) within ET. The three types of relationships discussed are predicated upon a belief in the need for a more cooperative paradigm between these two fields. Though the respective settings and target populations may vary somewhat since ET not only operates in education but also cuts across business, industry and the military, their zones of concern, nevertheless--instruction and learning--overlap. Heightened receptivity toward each other and cooperative ventures could better ground inquiry efforts, as well as multiply gains for both fields in advancing creative, responsive and responsible education.

Parenthetically, it should be noted that one could draft an endless list of crossfertilizations that could be (and have been) mutually beneficial between ET and other areas both inside and outside education. This paper is chiefly concerned, however, with the particularly curious nexus that exists between ET and teaching.

Three relationships, or loosely speaking, "models," will be discussed in the paper, preceded by a fairly lengthy delineation of ideological differences between how each field is perceived by the other. It is believed that differences need to be honestly addressed or collaborations will be thwarted. Each of the relationships can be simply illustrated by variations in arrow directions between the two fields. First, an arrow moving from teaching toward ET reflects what ET can learn from teaching and classroom realities. It asks ET to assume an Attentive Posture toward the field of teaching. The second relationship entails a more Directive, or Instructional Role on the part of educational technologists vis-á-vis pre- and in-service teacher education. (Certainly ET has its longest track record with this second model.) The third model, like the first, is less well explored and is depicted by a two-way arrow to indicate more Collaborative, Interactive Ventures in inquiry and development between ed. tech. and teachers, teacher educators and those who research teaching effectiveness and classroom processes.

I. An Attentive Posture

ET Inquiry ← Teaching and Classroom Realities

II. A Directive Role

ID → Teacher Education

III. Collaborative Ventures

ET Inquiry, ID & Evaluation ↔ Inquiry in Teaching, Learning and Classroom Practices

Unquestionably, examples of each of these three types of relationships exist within the literature and practice of the field, particularly in the second model, where courses in media utilization and production and ID principles have been injected into teacher education curricula and have "taken" with varying degrees of success. Nevertheless, two assumptions undergirding this paper are that the two fields have generally exhibited more condescension and competition than cooperation and collaboration (perhaps the territorial imperative is operant here), and that efforts need to be escalated from a position of respect, openness and experimentation. Both groups are guilty of stereotypical thinking about each other.

Here are a few indicators of the wind currents from our field toward teaching. It is no secret, for example, that it has been the aspiration of a number of educational technologists over the years to develop teacher-proof, if not also teacher-less, programs and materials. At the other extreme are Douglas Ellson's efforts to perfect a "programed tutoring" system whereby human tutors are programed to guide the learner through systematic, P.I.-type instructional sequences. (Ellson, Barber, Engle and Kempwerth, 1965)

And, frequently in the literature under the rubric, "obstacles" to development and implementation, one finds references to teachers' "resistance to change." Adjectives like "recalcitrant" (Cohen, 1970), "apprehensive" (Dunathan and Powers, 1979) and "fearful" (Ellison, 1970) crop up. Titles give away attitudes, such as "Goodbye Teacher" (Keller, 1978), "Why Teachers Fail" (Skinner, 1968), and "The Decline of Pedagocentricity," (Brabner, 1970). ("Pedagocentricity" is a term coined by Brabner to "designate the widespread practice of attributing overriding importance to teacher behaviors in the educational process." [Brabner, 1970]). But then little or no mention of teachers in the literature or in ed. tech. courses can be equally revealing. It is interesting, for instance, that there are no "teacher analysis" techniques in the ET or ID models. Thus, teaching-related issues appear not to be taken very seriously, issues such as individual teaching styles and decision-making processes, teachers' philosophical orientations and their reasons for being a teacher; teachers' relationships with students, colleagues and administrators, and how those relationships shape their expectations and their efforts. Major researchers and writers in the areas of teacher education and inquiry into teaching and classroom practices are seldom visible in ET literature.

Instead, teachers frequently seem to be portrayed as interchangeable implementers of the instructional sequence designed by the instructional developer. Dreams of a design science of instruction where products, processes, and outcomes of instruction can be prespecified, empirically validated and replicated further illuminate the educational technologist's vision of the role of the teacher. And even if this role is referred to as "manager of instruction," it may be glorifying what are really monitoring functions, thus treating teachers as "operators" rather than truly "managers," to use Davies' distinctions. (Davies, 1973) In light of the advocacy of more well-defined and accountable roles, it is ironic that in examining "The Teacher's Responsiveness to Technology and the Individualization of Instruction," Stewart and Love (1970) offer the provocative speculation that "lack of role clarity...[may enable] the teacher to creatively act on his own." Freedom breeds mediocrity, but it also breeds creativity, conscientiousness and ownership of one's actions. (Another finding heretical to some E.T. instructional principles is an article in Academe that purports, curiously, that good instructors may produce poorer learners. Students get the thinking done for them. Students who have [or perceive to have] poor teachers tend to study harder to compensate for classroom inadequacies and in turn frequently do better on exams than students of the best teachers. [Machlup, 1979]) Clarity and organization may indeed have diminishing returns.

All teaching functions tend to get subsumed under the categories within ID models of task and content analysis and instructional strategies decisions, rather than the other way around, as is more commonly the practice in schools and colleges; i.e., where teachers determine strategies, sequence, learning tasks and tests. The perpetuation of this latter means of devising instruction is not being advocated here, but the reverse situation seems equally questionable and rather unrealistic. It does not take into account the powerful influence teachers and classroom environment can exert over the learner during what Philip Jackson refers to as the "interactive curriculum," as contrasted with the "pre-active curriculum" that is preset by the developer. (Jackson, 1968a)

Ignoring or deprecating teachers may in part be a reaction to the veto-power they have over the "contributions" of ET, as teachers act as gatekeepers between educational technologists and their client, the learner. Teachers at the very least are prisms that refract (and thus alter) the instructional technologist's intended means and ends. Dennis Hoban discusses this gatekeeper factor functioning in higher education when he remarks that overlooking faculty teaching styles and priorities "has had serious consequences. Faculty can simply sabotage programs they do not like or do not know how to handle. Whether through opposition, disinterest [uninterest], or inability, professors have reduced many programs to parodies of themselves or to faintly disguised versions of what they were meant to replace. Naturally, this sort of failure leads to depression and cynicism. It is precisely this type of failure which instructional development may be able to avoid if it pays more attention to the needs of the faculty in its attempt to improve instruction." (Hoban, 1974) In short, there may be some good reasons why the best laid projects of I.D. have "failed:" reasons, rather than obstacles.

The problem is exacerbated if our professional self-image is one of macro-level change agent, engineers of efficient and effective instruction, or worse, cavalry charging onto an Education Battlefield strewn with No Significant Differences. Our struggle to carve out an identity, a position of strength and vision resting on demonstrable competencies that are more than a collection of tools, skills and services, is characterized by Heinich as "functions in search of a profession." (Heinich, 1980) The contrast is great, however, between an "aids and services" persona--a hawker of media--and thus someone who belongs at the later "strategies decisions" stage of the ID model VERSUS one who controls and orchestrates the entire instructional process from needs assessment through design and evaluation.

The wind currents from the other direction, from teachers and teacher educators toward ET also reveal acrimony or disregard. Of course, the worst rub is to equate the field with "audio-visuals," which, carried to its logical extreme implies one could go for a Ph.D. in wet mounting. Actually we reinforce this A-V association inadvertently when the courses offered to and taken by students outside the field (usually teachers-to-be) are largely media utilization and production courses. Disconnecting these solution-oriented courses from the context of instructional exigencies and problems further minimizes their wise integration into the classrooms of the future. Thus, the Big Picture of educational technology and the immensely valuable and challenging systems perspective of instructional processes with its emphasis on descriptive analysis and problem-solving, combined with its rich repertoire of alternative solutions are lost to this population of future bedfellows.

Interviews with teacher education faculty at Indiana University yielded interesting perceptions of the field, referred to at I.U. as Instructional Systems Technology, or IST. Some equated it with hardware, of course. One person knew it had something to do with better communication and improving teaching, but he wasn't sure just what that involved beyond making A-V materials. No one could name the tracks within the department or define the difference between IST and instructional development (which, by the way, is increasingly harder for people in the field, as well, if one thinks of ID models as embracing needs assessment, management and production functions along with the design and evaluation stages). Most could offer no names in the field outside I.U. faculty.

One respondent criticized the "nuts and bolts" preoccupations of IST and recommended it come to grips with underlying philosophical issues--the why, not just the how of instruction. In response to a question about possible ways the two fields might work together, he advocated more personal relating and sharing of ideas and common interests. Curiously, no one offered specific suggestions for instructional or inquiry linkages.

Another faculty member who professed to have experience in IST methods and media came down hard on the field for trying to teach people something they don't necessarily want to learn. The payoff appears to be getting them to do it regardless of intrinsic rewards, its importance to the learner or relevance to what s/he values or aspires to. "IST seems to blindly accept the basic premises of [traditional] schooling that it's okay to manipulate students so they're almost tricked into learning things they have no interest in learning." (This insight is ironic in light of the fact that our field prides itself on being learner-centered and in the avant garde of educational progress: it appears instead that atavistic assumptions may lurk beneath its innovative façade. Innovations may indeed be only skin deep. Early educational television maintained the lecture as the staple medium of classroom communication; the currency of programmed instruction and computer assisted instruction were [are?] essentially facts and information and called for the oldest learning routine--drill and practice. [Torkelson, 1977] Alfred Ellison speaks, too, of the anomaly of early CAI developments by engineers who utilized it to provide "an antediluvian, outmoded, discredited approach to the teaching of mathematics," for example. [Ellison, 1970] In short, the most traditional instructional tactics may be disguised in technological finery and passed off as innovation. Those who criticize or reject the "innovation" are then in turn said to be recalcitrant, fearful and resistant to change.)

This interviewee also asserted that the machine talk, the technocratic language of IST is threatening, alienating and totally unnecessary. "Humans don't talk like that," he said. The effort is toward "education as science"--which is too systematic and impersonal a stance; the message seems to be "ban humanism at full speed."

Derek Rowntree, a British educational technologist, criticizes the field similarly:

> Sometimes...I suspect that the opacity of the prose and the elaborate jargon is used not as window-dressing, nor as a result of the author's shaky grasp of his ideas, but in order to anesthetize the reader against the full impact of what is being said. This is especially

> noticeable in the works of some American writers whose experience of systems analysis has been in industrial, business and military contexts and who are convinced education can be "engineered" in the same kind of way. The "engineering approach" to education can offer useful insights that would otherwise be unattainable, but its dehumanized rhetoric is often too evocative of the assembly line, and of factory ethics and commodity economics to win much of a hearing from teachers. (Rowntree, 1974)

The responses of the teacher educators interviewed were surprisingly harsh but also surprisingly articulate and incisive. One would almost prefer to be seen as a trusty, dependable Leroy letterer. Briggs recently wrote that "In our desire to capitalize upon technology, self-instruction, and individualized instruction, we have neglected the detailed redefinition of teacher roles. We have, therefore, made teachers uncomfortable, if not hostile, to our technology. So, in general, we are stronger in technology and principles than in public relations." (Briggs, 1980) Indeed if this were Madison Avenue, we would purge our entire p.r. department and start all over again. I would offer, however, that the essence of the problem--or solution--is not, as Briggs suggests,"neglecting the detailed redefinition of teacher roles." Such a view still perceives the teacher not as colleague or collaborator but as learners--as a target of our I.D. models and strategies.

One last point about the interviewing technique is that it can be an enlightening experience. Harold Stolovitch has students in one of the graduate instructional technology courses he teaches "query two people working in the field, two educators not involved in IT, and two persons-in-the-street who have no professional dealings with education. They pose a simple question: 'In your own words, what does the term Instructional Technology mean to you?'" (Stolovitch, 1980)

Interviewing outsiders reveals remarkable philosophical clashes between educational technology and other areas within education. Preliminary to discussion of the three types of relationships that are possible between ET and teaching, it might be valuable to pursue these philosophical differences even further. It is likely that before a truly cooperative paradigm can emerge between the two fields, each needs to better understand the other's philosophical underpinnings and explore how each field perceives the other. There may turn out to be surprisingly large variance in teleology, axiology, epistemology and praxis across the two fields. Hopefully, the gulf is not so wide that campaign tactics as outlined in the three models would be abortive.

Dan Lortie in his book, Schoolteacher: A Sociological Study (1975), reviewed surveys of public school teachers and discovered recurrent themes among teachers of conservatism, individualism and presentism. Also, teachers ranked relationships with students as equally important as instructional goals; a finding that corresponds to their valuing psychic rewards higher than extrinsic (monetary) or ancillary (fringe and compensatory) benefits as the predominant type of self-reinforcement over which they had control.

Pit these characteristic outlooks of public school teachers against ET perspectives, and differences are apparent. Instead of being conservative, individualistic and present-tense, ET sees itself as innovative, experimental, scientifically based, and futuristic. Ed. tech. tends to operate at a macro- or molar level, rather than a micro- or molecular level of instruction with its connotation of and greater potential for individualistic teaching and learning. Psychic rewards of teachers (and students) get lost in empirical validation and replication of learning according to prespecified behavioral objectives. The satisfaction of the teacher or student is a bonus but not a goal or criterion of success--a view reinforced by research findings telling us that learning is not highly correlated with liking.

Another teacher characteristic which has implications for us is that, according to Paul Houts, editor of The Elementary School Principal (1977), teachers tend to be print-oriented since "most teachers and principals grew up in a time when print materials were still the source of most information, certainly the primary source of scholarly information." Obviously there are implications here for the credibility of non-print media as a viable instructional option. (An element of hypocrisy is evident in ET, as well, when one discovers predominantly linear, verbal presentation of information in its journals, particularly its scholarly journals; and the margin for divergence into nonverbal domains is practially nonexistent in doctoral dissertations. The author of this paper must plead guilty on the same charge.)

Philip Jackson in The Teacher and the Machine (1968) contends that teachers prefer flexible, adaptable technology--a preference which in part explains the preponderance of chalkboard and textbooks in the classroom. Besides being so familiar, so traditional, chalkboards and textbooks don't have to be reserved weeks in advance, don't blow a bulb, and don't require extension cords.

Jackson warns that some of the ideological differences may be incompatible. His criticisms are reminiscent of the Rowntree quote earlier: "Many of the technological tools now being designed for use in the schools are being promoted by men who talk and think like engineers. The teaching machine is a good case in point." (Though Jackson is writing in 1968, his concerns are not drastically different today.) "To its promoters, the machine has a great logical appeal. Here, at last, is an invention that promises to reduce errors, increase efficiency, speed learning, cut manpower costs, and ultimately transform teaching from something resembling black magic into an applied science." (Jackson, 1968a)

H. M. Harmes, writing in 1970, puts together a similar list of Ed. Tech. criteria for educational improvement--a list that even today would probably be largely adhered to by most professionals in the field: effectiveness, objectives aligned with goals, increased efficiency, reduced undesirable side effects, increased reliability, and more objectives accomplished.

Teachers' "resistance" is probably not due to inadequate information or vision, nor to their intellectual inferiority, but to their having a very different attitude toward their work, their students and the world in general. Efficiency, logicality, accountablity and error-reduction simply may not be their guiding values.

It is worth pointing out, too, that ET may be guilty of reinforcing some of the norms and values most frequently attacked in the "hidden curriculum" literature, norms such as compliance and self-detachment within the learner from his/her own experience. Neatness and efficiency may be valued over creativity. (Jackson, 1968; Eisner, 1979) In fact creativity, curiosity, initiative, individuality, uncertainty, critical thinking and iconoclasm are not typically nurtured or valued. It's difficult to program tham a priori into instructional sequences. Constraints on the inculcation and expression of these dimensions are thus likely features of ID products. Valuable insights can be gleaned from the hidden curriculum literature: it asks that the implicit "messages" concerning the student's role and capabilities being fostered be scrutinized. What norms and values are inadvertently being reinforced? What contract is the student being covertly asked to agree to? What kinds of knowledge and ways of learning are being valued--and devalued? And can this level of criticism, of meta-instruction and meta-learning, be surfaced and become an overt dimension of the learning act, whereby learners consciously process the intent, meaning and effects of their learning experiences?

In a participant observation study of special education teachers, Syracuse researchers came up with several findings that also have serious implications for

ET development and diffusion practices. Dodge, Bogdan, Brogden and Lewis looked at "How Teachers Perceive Media" and found that "control over student behavior was the dominant theme throughout the study, and though each teacher exhibited differences in the extent of control desired, all indicated they disliked and resisted forces that might reduce their control or precipitate disruption." Thus, "one important criterion in the teacher's evaluation of a resource input from outside the system is: how does it affect the control that has been established in the classroom? An object--material or human--that is perceived as having the potential for being distractive to children or disruptive of routine is negatively prejudged by the teacher as one more thing in the class for her to worry about." In other words, "teachers depend on the structure and resist attempts at changing that structure. Therefore, the way in which teachers under observation typically employed resource inputs was to integrate them in their established routines--without noticeably changing their schedules and styles." (Dodge, et.al., 1974) This integration process might mean altering the intended instructional uses and goals altogether.

The observational work in normal school settings by Jere Brophy and his colleagues indirectly triangulates the Syracuse study's conclusions regarding the importance of control for the teacher. In a conference presentation at I.U. in 1978, Brophy discussed the significant effects that classroom monitoring and management have upon learning. Kounin's factors of "withitness" (awareness of what's going on) and "overlapping" (the ability to handle more than one person, group or activity at a time) proved to be meaningful frames for examining classroom practices. (Brophy, 1978; Kounin, 1970)

The juggling ability of teachers, the amount of "down time" during the class, signal continuity, group alerting and accountability tactics, disruption prevention behaviors, and pacing relative to the type of learning desired are all factors listed by Brophy as pertinent to the effectiveness of teaching to maximize learning gains. (Brophy, 1978) Yet classroom management issues are seldom if ever dealt with in the ET literature. (The reason is probably partially due to ET's military, business and industrial frames of reference where facilitating and managing group interactions do not need to be as high a priority as in public school situations with younger populations.)

With regard to the use of "resource inputs," Lortie remarks that for the teachers surveyed, to adopt a practice it had to be seen as consistent with their personality and conventional way of doing things. "They portray diffusion of classroom practices as passing through the screen of the teacher's self-concept--by the way he visualizes his peculiar style of work. Thus individualism and gatekeeping are reaffirmed." Timing, as well, and felt need emerged as critical factors in teachers' receptivity to new ideas and inputs, according to Lortie. (Lortie, 1975)

The teacher's self-image as a manager of people and processes in the classroom thus appears to be of central concern. In short, teachers appear to operate in teacher-centered systems; a first priority is control over and self-assurance about the environment. Educational technology's priorities, on the other hand, are quite different. Historically it has been media-oriented; more recently it has felt a strong allegiance toward objectives-centered systems with heavy emphases, too, on content and task exigencies. Increasingly, a problem-centered approach appears to be the pivot of ET and ID.

Again it is critical to point out that the message intended here is not that ET should rewire its priorities altogether nor acquiesce to the status quo. The opposite position--ignoring or overriding classroom realities--is, however, counterproductive and results in self-sabotage. Surfacing implicit assumptions, allegiances, goals and intellectual origins of the respective fields of ET and teaching is quintessential to bringing about changes in education that are beneficial, effectual and adopted. It is an important first step as well as an ongoing challenge.

The following descriptions of the three types of relationships between ET and teaching reflect optimism that the philosophical disparaties between the two fields, if recognized, are surmountable depending largely on the stance taken by ET toward teachers and classroom exigencies. Extant and possible examples within each of the models will be briefly alluded to, but far more acknowledgement is due writers and practitioners in the field who have embodied the cooperative paradigm in their professional relationships with teachers over the years.

The first relationship asks ET to assume a more open, attentive and heedful posture toward teachers, teaching acts, and classroom processes. What do teachers really do in their classrooms? How do they read meaning into student behaviors and alter expectations, demands and instructional moves from minute to minute? In other words, how do they make decisions, and on what input are the decisions based? (Jackson [1968] considers that teachers perhaps make as many as 200 decisions an hour.) What information presentation strategies are utilized: for instance, when and how are metaphors, examples and self-disclosure employed? When and how are creative and critical thinking sparked? When and how are inductive versus deductive styles chosen, or are they mutually exclusive? How are media misused, perhaps sometimes in order to achieve more relevant or creative results? How does classroom communication, both overt and implicit, mediate the perception, utilization and effects of innovations? ETC. (The phrasing of these questions implies the possibility of homogeneity among teachers and among answers. Individual differences in philosophy, learning and teaching styles, and contextual influences abound, of course. It may be, too, that the questions would yield more valuable information if directed at "good" teachers rather than all teachers.)

An arrow pointing from teaching toward ET symbolizes what ET can learn from the field of teaching through direct inquiry into and awareness of research in teaching effectiveness and classroom communication processes, as well as the socio-political component of schooling. Problem formulation that is grounded in classroom priorities and practices can open up new avenues for ET inquiry and inform the practices of the field in development, logistics and diffusion. Signposts in the journals are pointing in this direction. The writings of Gavriel Salomon and Ann DeVaney Becker are encouraging grounded theory, ecological research, and the use of qualitative methodologies to explore a variety of ET concerns. IN an AERA presentation in Boston last April, Charles McIntyre summed up the results of much ET research as yielding the "Goldilocks Effect." Media have been found to be effective when they are not too fast but not too slow, not too complex but not too simple, not too lean but not too repetitive; they're effective when they're j-u-s-t right. (McIntyre, 1980) Grounding research questions and hypotheses can help us out of this Goldilocks tautology.

Both Michael Scriven (1980) and Ernest House (1980) have expressed concern about implicit values that may be embedded in initial problem formulation processes and final data interpretation stages of experimental research. Generally only the design and data analysis methodologies undergo scutiny; yet they represent only the tip of the iceberg of all the decisions made throughout the experiment. Grounded theory and naturalistic methods, ironically--despite their subjective connotation for many people--may be better suited to accountability for sources of decisions at each stage of the inquiry process. Also, the leap from naturalistic inquiry to implications for practice is an easier, more isomorphic one than the leap from experimental, laboratory research to classroom practice, despite nongeneralizability of results (since naturalistic inquiry does not claim to generate context-free knowledge).

D. C. Phillips in the December, 1980, Educational Researcher challenges the assumption, too, that research results should be translated into classroom practice. An invidious "linking value premise" is evident. E.T. has been culpable historically for trying for direct linkages between behavioral science research and instructional applications. It has overlooked implicit values in making this leap and superimposing a behavioral science world view on reality. Such an allegiance may have created a kind of tunnel vision.

Boutwell and Kaufman, guest editing the NSPI Journal in 1979, chastised the field for having lost its sense of inventiveness and for not being sufficiently open to divergent ideas, beliefs and procedures. It has tendencies toward being defensive and getting caught up in professional subgroups that reinforce elitism. (Boutwell and Kaufman, 1979) Robert Diamond has recently criticized I.D. in particular for tending to be "naive and isolated." "If this field is to grow into a profession," he writes, "we must pay as much attention to our own learning as we do the learning of our students. Too many of us are too narrow, and over time, this could become costly." (Diamond, 1980) (A provocative parallel could be drawn here between the paradox of eclectic, experimental, melting pot America struggling with ethnic and racial intolerance and the paradox of eclectic, experimental, melting pot ed. tech. struggling with intolerance of different perspectives of instruction.)

Attention to teachers teaching and learners learning in large and small groups or tutorial situations at all levels can help break down this inbreeding and trigger fresh insights that can be translated into a variety of inquiry, development and diffusion alternatives. A deeper look into teaching styles, too, may provide treatment variations in ATI research. In sum, as Heinich writes in 1970, "...We may find that the research on teacher behavior may combine with media research to produce an optimal mix." (Heinich, 1970)

The second relationship posed for ET and teaching, specifically pre- and in-service teacher education, is the one most frequently encountered in the literature. Though the first type of relationship requires attentiveness to teaching and learning in classroom contexts, it does not tackle teaching-related problems head-on, as does this second model by which the fields of ed. tech. and teaching can work together to improve the quality of education. A Directive, or Instructional, Role for educational technologists is depicted by an arrow directed from ET toward teaching.

The earliest forays into teacher education involved media utilization and production courses, which are, of course, still pervasive. One example of a fresh approach in this area is a program initiated at Iowa State University for teacher education undergraduates. The course commenced with classroom work involving discussion and demonstration; the formal classwork phase was then followed by laboratory projects in media. The third phase of the course had students observe in public school classrooms for a minimum two hours a week; each student would observe in a particular class, consult with the teacher, and work with the students in the class. The undergrad would then work together with the teacher to plan a media project which the student would then produce for the cooperating teacher's classroom, as well as submit to the university class for credit. (Simonson and Volker, 1974) The course outline is an elegant blend of theory and practice that is grounded in reality. Seeing media used and integrated into actual courses, being a partner to media selection and utilization decisions, and having hands-on production experience combine to form a valuable and realistic learning opportunity.

The challenge has existed and still exists to also infiltrate teacher education with systems thinking and ID approaches to instructional decision-making. Fewer courses in these areas tend to be available to non-ed. tech.

majors than the media utilization courses. Though the preface of ID texts typically lists teachers among their intended audiences, it would be interesting to find out how many of these texts get into teachers' hands. Actually there has been a debate in the literature as to whether teachers can or should be their "own best instructional designer." Gabriel Ofiesh in a taped conference dialogue with George Gropper argued that "teachers have no business preparing instructional materials." (Gropper and Ofiesh, 1972) David Merrill, on the other hand, considers "that teachers can be instructional design technologists; this, in fact, is what teaching is all about." (Merrill, 1971) Edmonds and Pasch (1974) also pose the question of whether the teacher is a consumer or a designer.

In an article on "Interactive Teaching and Instructional Development: Emergence of a New Teaching Model," Thiagarajan describes his own evolution in trying to teach ID to teachers. He discovered they had neither time to utilize the skills nor support to package the instruction. Thus revisions were necessary. He arrived at a compromise whereby many principles of ID are incorporated in the course yet elements of face-to-face teaching are also retained. He reworked ID strategies to adapt to teaching: the model is broken down into pre-instructional strategies, an interactive instructional phase, and post-instructional objectives. (Thiagarajan, 1974)

Thiagarajan's compromise signals the kind of responsive, reciprocal adaptation that is called for in the ET-teaching interface. Articles by Thomas and Jones and by Zimmerman and Lavin both urge in-service efforts that are responsive to the content, process and scheduling needs of teachers. Teachers must be involved in the decision-making. (Thomas and Jones, 1974; Zimmerman and Lavin, 1974) Thomas and Jones argue the advantages in particular of closed circuit television for shifting the responsibility for content and scheduling of in-service activities from the administration to the teachers. (Zimmerman and Lavin, 1974)

Jo Anne Craig goes even further in acknowledging the psychological risks the teacher may undergo when asked to alter his/her perception or model of teaching. The growth process involves value shifting. "The styles that faculty are using are those which have been successful for them. Individuals tend to continue behaviors which first enabled them to cope with situations." Thus choice and a sense of being in control need to be taken seriously when one is planning in-service activities. Craig recommends moving through six phases in order to optimize the faculty growth process: 1) Awareness, 2) Evaluation/ Identification, 3) Selection, 4) Experimentation, 5) Acceptance, and 6) Assimilation.

Faculty development efforts in higher education represent a progressively larger strand in the literature. (Craig, 1976; Simerly, 1977; Abedor and Sachs, 1978; Schwen, Leitzman, Misanchuk and Foshay, 1979) A faculty development orientation tends to shift and therefore challenge the classic role of the instructional developer from program and product designer to process consultant, strong in problem-solving and "people" skills. The teacher is the center of gravity and maintains ultimate control over implementation and adoption decisions. This power is contrary to the position afforded the teacher in the systematic, textbook version of I.D., and in Heinich's hierarchical paradigm of ed. tech. (Heinich, 1970) Schwen et.al. (1979) characterize the instructional developer's role as entailing a "social intervention," combining expertise in ID, FD, and organizational development (OD); it does not attempt to impose a rigorous, systematic ID model on the problem situation.

Lortie contends that one reason for teacher frustration and perhaps why teaching is not taken any more seriously as a profession is that there is "no generalizable body of knowledge and practices," no "technical culture" upon which they can rely. "Teachers...work largely alone," and "they possess no special concepts (legal, philosophical or sociological) for describing their plight or analyzing alternatives. Their professional training has not...linked recurrent dilemmas to available knowledge or to condensations of reality (e.g., cases, simulations) where such issues are deliberated." Teachers do not share a common "memory" or technical structure to help them cope with even routine or strategic problems." (Lortie, 1975)

On both theoretical and practical levels, principles and skills embraced by educational technology and instructional development within ET have a great deal to offer teachers. A systems view of the learning environment, for example, broadens the vista of concerns, explanations, and options. The experience with ID concepts and strategies has the potential for lifting the burden of accountability off the teacher and the burden of failure off the learner, shifting it instead to more neutral ground--to instructional choices, processes and products. Rowntree encapsulates instruction as essentially one of deciding when and how to use what. (Rowntree, 1974) Conceiving the instructional process as a Sherlock Holmes adventure in puzzle-solving and solution-generating frees up how one sees the "givens" versus the "possibles," and in turn puts the teacher in a much less vulnerable position both personally and legally.

The relevance and value for teachers in pre- or in-service training of the following aspects of the ID process seem self-evident:

- General needs analysis, defining curricular priorities, and specific problem analysis.
- Determination of human, material and situational resources and constraints.
- Formal and information analysis of learner abilities, aptitudes and cognitive styles, background experience, entry skills, interests and learning preferences.
- Task and content analysis.
- Matching instructional strategies and learning experiences with learner needs and goals.
- Selection, utilization and production of materials.

- Techniques for evaluating students' performance and experience, as well as the teacher's own performance and experience; helping students process their own learning. (Helping students become their own best teachers and evaluators may in fact be the single most important goal of education.)

Fuller and Bown identify three developmental stages of concerns for teachers. They are: 1) survival concerns--concerns about control, performance and presentation of self; 2) teaching situation concerns--concerns about time pressures, lack of materials, frustration with working with so many students and not getting enough accomplished; and 3) pupil concerns, where the focus shifts to emotional and social needs of pupils and concerns about tailoring curricular materials to the individual. (Fuller and Bown, 1975) Teachers can feel all of the issues of the stage they're in.

These stages of concerns carry meaning for the educational technologist engaged in teacher education. Differences between the concerns of beginning teachers and experienced teachers need to be taken seriously. On the other hand, awareness of the stages of concerns can fortify the ET "teacher educator" because it is likely that the systems approach to instructional problem-solving, conjoined with specific ID strategies and materials options, has tremendous potential for addressing a number of issues within the three stages outlined by Fuller and Bown. Ed. tech. can offer conceptual and pragmatic bridges to coping with a variety of classroom concerns. It also "could provide the teacher," as Hoban writes, "with a deeper understanding of his own teaching and provide him with the often needed degree of self-confidence necessary to teach well." (D. Hoban, 1974) (Of course, the collective unconscious of ET may be reluctant to diffuse itself in this fashion, disseminating its own technical knowledge base to others in education. To do so may seem to threaten its professional identity. To paraphrase Kissinger: power is getting others to think you know something they don't. A more altruistic, less self-preservational way of looking at it, however, is that perhaps it should be the goal of ET to work itself out of a job.)

The third relationship emphasizes collaborative, equilateral efforts between educational technology and teachers, teacher trainers and researchers for the purposes of jointly formulating questions and conducting inquiry to enlarge their knowledge base, and consequently bring about more meaningful and effective development and dissemination of that knowledge. The arrow moves in both directions to illustrate this dynamic, interactive relationship.

A variety of models are possible within this interactive inquiry and development frame. An AERA panel presentation at the 1980 Boston Conference offered three possible models with varying degrees of teacher involvement and responsibility. No one on the panel was specifically addressing ET concerns at the time, but the bridge to our field seems an easy one to make.

In the first model teachers' observations and reports from their own classrooms helped researchers mold their questions, hypotheses and designs for further research. (This model is comparable to the first relationship described earlier in this paper.) This proposal, interestingly, was put forth by Anne Bussis of Educational Testing Service--the bastion of quantitative research and measurement. Bussis argued the merits of qualitative, naturalistic methodologies in researching teaching effectiveness.

In the second model, teachers also engage in the exploratory stage of problem formulation, with the addition of follow-up mini-experiments with them to determine their efficacy in light of the particular research problem being looked at. Teachers are given the results from this experimental phase; then they engage in workshops geared to help them remedy any weaknesses revealed by the experimental data. (Needels, 1980)

This second model is reminiscent of Rosenshine and Furst's recommendation for a three stage process of educational research that encompasses both field study and experimental approaches. They refer to this model as the "descriptive-correlational-experimental loop," though the sequence of stages in the loop is not necessarily a fixed one. (Rosenshine and Furst, 1973)

The third model presented at AERA by Beatrice Ward of Far West Educational Laboratory represents the most equilateral treatment of the teachers' and researchers' roles, and reflects the teacher not as someone to be "redesigned" post-research, but as a "self-researcher." The teacher is a key agent in defining the problems in the classroom and in rank ordering the seriousness of these problems. Ward stressed that teachers' receptivity to remedying problems is relative to whether they assess the needs and problems commensurately. In the Far West Lab project teachers were equal members of the team throughout the experience and worked with researchers and teacher trainers to explore and devise alternative classroom strategies.

Ward listed four criteria for successful teacher-researcher collaborations: 1) parity and genuine belief in each member's contribution, 2) equal assumption of responsibility, 3) recognition and utilization of emergent leadership behavior, and 4) consistent sharing of feelings and ideas. She noted that the researcher on such a team needs to be especially eclectic and flexible. Surprisingly, the hardest role on the teams to fill was teacher trainer: they tended to be the least flexible and open in this dynamic, iterative process. (Ward, 1930)

Collaborative, interactive research and development activites between educational technology and teaching would surface a plethora of new ideas for inquiry, development and diffusion, and result in more relevant and substantial gains in educational practice. They inculcate in the teacher, researcher and developer a sense of ownership of educational problems and possibilities. Such ventures also significantly diminish the time lag--typically five to ten years--between educational research and adoption.

Sally Jorgensen
AECT, April 1981

"A CALL FOR A TRUCE BETWEEN ED. TECH. AND TEACHING: SUGGESTIONS FOR MUTUALLY BENEFICIAL COLLABORATIONS"

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Reconceptualizing the Theory - Base of Educational Technology: Re-opening the Theory - Practice Debates

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J. Randall Koetting
Visiting Assistant Professor
Acting Coordinator of Clinical Experiences
Oklahoma State University
Stillwater, Oklahoma 74078
(405)624-6253

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RECONCEPTUALIZING THE THEORY - BASE OF EDUCATIONAL TECHNOLOGY: RE-OPENING THE THEORY - PRACTICE DEBATES

Introduction: The Need for an Expanded Theory - Base in Educational Technology

The interplay, or dialectic, of theory and practice is a critical issue within the discipline of education in general, and the field of educational technology in particular. Media and education are not only timely topics for analysis and discussion, but practical concerns for those involved in the everyday practice of teaching. The practical concerns, I believe, can be clarified through critical discussion of the theory-base for our field, and _vice versa_: the practical concerns enlighten the discussion of the theory-base.

Educational theorists/practioners recognize theory embedded in certain practice, and certain practice embedded in a theoretical base. The theory base for educational technology, as a field of study, stems primarily from behaviorist and cognitive learning theory. These theories establish a certain view of what is considered to be valid knowledge, the characteristics of learners, the educational outcomes of schooling in general, and the means of evaluating what happens in classrooms. From this theory-base we build our practice.

Following behaviorist theory, for example, we arrive at a certain view of education in general. We have a specific understanding/definition of knowledge, a definite understanding of the learner and learner "characteristics", an understanding regarding what is considered legitimate "knowledge", and a definite manner in which curricula are organized and evaluated. And all this stems from the theoretical base of behaviorist learning theory.

Behaviorist theory is a valid empirical base for building a field of study, such as educational technology. However it is only one theory, as is cognitive theory, as is gestalt-field theory, as is psychoanalytic theory, etc. There are alternative views of education that start from radically different positions than behaviorist theory, and I would suggest that they are valid ways of viewing education, a rather complex social reality. Starting from a different theoretical base will not only suggest, but require a re-conceptualization of our present view of the teaching/learning situation. This reconceptualization will primarily focus on the subject-in-context (learner), what is considered "knowledge", and means of organizing and evaluating curriculum content. If we, involved as we are in a field of study within the broad scope of education, want to stay in the main current of educational theory and practice, we must expand our theoretical base to include, or recongize, other valid views and approaches to education that are not within the behaviorist tradition.

I want to emphasize that I am not negating the value of behaviorist theory applied within our field of educational technology. Behaviorist theory has its place in education in general. What I am suggesting is that we look to other interpretations and understandings about schooling, and seek ways to utilize and integrate media for instruction within alternative frameworks.

Fruitful areas for exploration will lead us to the conceptual level first. This will necessitate our becoming involved with theory. We need to examine the notion of knowledge, which is different than information and factual data. We need to examine the notion of subject-in-context, i.e., learners and their interaction with their life situation. We need to re-examine our conceptual understanding of curriculum organization and evaluation of educational outcomes. In examining these theoretical understandings, a new praxis can and will emerge.

My contention is that the educational context, the teaching/learning situation, is an extremely complex situation. Reducing this situation to a question of inputs and outputs oversimplifies the many facets of education. We need to view education in its complexity and begin to deal with some practical solutions. The practical solutions cannot be arrived at until our theoretical understandings are clarified.

As stated earlier, there are alternative frameworks within which we can describe the educational context, both in thinking about the learning process and in inquiring into that process for purposes of research. My focus in this paper will be on Freire's emancipatory model of education, a model that allows for the complexity of school life and is able to work with alternative forms of inquiry (other than the empirical model) in arriving at knowledge. In proposing Freire's model of emancipatory education as an alternative to the behavioral model of education, the application and utilization of educational technology also takes on an "emancipatory intent" in the learning process, as opposed to being clearly defined for the purpose of control as in the behavioral model.

In proposing the emancipatory model of education I am not implying that this is the only alternative answer to the behavioral model, but rather pointing toward a possible direction in which an alternative conceptual framework for understanding the learning process can be legitimately accepted. To ask for a substitute to the behavioral model, or one alternative is to

> Confirm the assumption that utterly complex problems can be resolved easily within the accepted framework, and without the ambiguous and awesome necessity of engaging in the crucial task of challenging or at least illuminating the framework itself. The task is not to find the one acceptable alternative that will enable us 'merely' to control our schools better. Rather, it is to begin to disclose the problems associated with our commonsense views of schooling and to begin to open up and explore conceptual and economic avenues that seem fruitful and may enable us to see and act on the complexity rather than define it out of existence (Apple, 1979, p. 121).

To break out of the scientifically-oriented view of education, i.e. the behavioral model, requires radical change in our views of education. Philosophical issues, such as epistemological understandings and analyses as presented by Habermas' theory (1977), our concept of the nature of the person, our view of the relation of the person and specific context,[1] the question of the relation of theory to praxis, etc., need to be examined within their philosophical context and become part of our educational praxis. In this paper I will present Freire's emancipatory model to provide an alternative conceptual framework within which the learning process can be discussed wherein the complexities of that process are acknowledged.

Part I: Paulo Freire's Emancipatory Model of Education

Paulo Freire (1970, 1973) presents a model of education that has as its intent an emancipatory interest. Emancipation (liberation, humanization) is brought about by the subject's critical awareness of self and his/her surroundings (context), the awareness of the subject's power to transform that context (praxis) and hence emancipation from self-imposed or contextually imposed constraints. The aim of emancipatory education is the humanization of the species. Humanization of the world is the goal of social life.

Freire proposes an either/or view of education: either the educational situation (context) fosters freedom from constraints (emancipation-education for cultural freedom), or it fosters the dialectical opposite, which is education for domination. The *subject* ("learner") and the subject's *context* (circumstance) and status/power within that context become crucial understandings that require interpretation.

The term "subject" refers to the "person-in-context," the person as situated within a social context.[2] The meaning of this reality is more rapidly grasped by Ortega's (1969) statement "I am myself and my circumstance." The notion of subject is not merely a substitute for the term "learner" as found in the behavioral, scientific model of education. Learner, in that context, connotes passivity, or at best, minimal activity in the form of responses made to certain "stimuli" as the student "participates" in the learning activity.

The form of critical awareness of "self-in-context" and the capacity to transform that context, *i.e.* to bring about emancipation from self-imposed or contextually imposed constraint, is the emancipatory interest of critical science (self-reflection on the self-formative process leading to emancipation from seeming "natural" constraint). In this respect, Freire's model incorporates a definite mode of rationality that Habermas (1971) refers to as critical science.[3]

The educational praxis[4] resulting from the framework is shaped primarily by Freire's view of the subject (person-in-context). The subject's consciousness and ideology is determined by social context, social environment. The nature of those determinants, the social context itself and the subject's action within that social context are the concerns of emancipatory education. Freire's pedogogy makes "oppression and its causes objects of reflection" (Freire, 1970, p. 33). An act is oppressive "when it prevents men from being more fully human" (Freire, 1970, p. 42). To further explicate the notion of oppression, I need to give a general sketch of the social structure that would be termed oppressive.

Society and the Subject

A view of the world as static and unchanging is seen by Freire as false consciousness and an indication of domination. The subject (person), because of this fixed nature of the world, must adapt him/herself to the structure. Social forces exist over which the person has no control. Authority in various forms, institutional, managerial, political, individual, etc., is a force unquestioned regarding its origins and nature; and its legitimation rests partly in the subject's blind acceptance of it, and partly in its shear "strength/power" against any form of opposition. A society in which the members exist in an unchanging world, in which they are powerless, and in which they recognize an unchallenged authority is dominated, ruled by force that controls (consciously/unconsciously) and overwhelms the members of that society. As Freire states it, the person is "submerged" in reality, unable to perceive the interests of the oppressor-society.[5] It becomes the task of emancipatory education to unmask the "seeming constraints" and work through the "contradictions" of society. The interest of emancipatory educational praxis lies in the "emergence" of the subject along with his/her critical capacity to transform the world (Freire, 1970, pp. 48-56).

The subject in Freire's model views social reality as a production of individual or group effort, and hence changeable. Change is an invariant condition of life itself. The transformation of the oppressive context is an "historical task, a task for men" (Freire, 1970, p. 36). This transformation of the context is praxis. Praxis is seen as "reflection and action upon the world in order to transform it" (Freire, 1970, p. 36). Authentic liberation (the process of humanization) is praxis (Freire, 1970, p. 66).

The subject is always in context, a concrete, existential situation. The only "givens" in life for the individual are birth and death. The historical-biographical reality within these two points belong to the individual, and the individual creates him/herself by the choices they make. ". . . there is no history without men, and no history for men; there is only history of men, made by men and (as Marx pointed out) in turn making them" (Freire, 1970, p. 125). The social context shapes consciousness of self.[6] Responsibility for historical-biographical life belongs to the subject. The fullness of freedom is not present until there is an awareness of freedom (total responsibility for one's life), a commitment and dedication to that freedom in self and others, and action on that understanding and commitment (critical consciousness and praxis). The perception of self as autonomous, in control of and responsible for personal life-in-context implies, or assumes, that society is changing and changeable. The subject exists in the society, is co-existent with it, and is partially defined by it. It is the subject's co-existence with reality that is "life". Intervention in reality brings about changes and goes beyond mere adjustment or adaptation. The intervention, the integration with context, is the critical capacity to "make choices and to transform that reality.[7]

The link between consciousness and context (social context) is crucial to an understanding of Freire's framework for emancipatory education.

Awareness of social forces, social "constraints" on the subject, reflection upon those forces/constraints, and the capacity to transform that context is praxis. Understanding of how we are shaped by these forces, and the fact that we are shaped by these forces begins the process of emancipation.

A subject, unaware of self as a "controlling agent" of his/her life, does not act in that life but is acted upon and is an "object" of social reality, propelled by social forces. But awareness of these forces, and consciousness of the nature of these forces enables the subject to take part in self-formation and the formation of society.[8] Consciousness here recognizes intentionality (*i.e.*, will) as essential to self-formation. Consciousness here is "turned in upon itself" (self-reflection) and has an emancipatory interest (*cf*. Freire, 1970, pp. 66-7).[9]

Habermas (1971) re-introduced the notion of self-reflection to epistemological reasoning. Similarly, Freire introduces the notion of consciousness to the realm of education as a means of gaining knowledge of self-in-context. This means of gaining self-knowledge has a definite emancipatory intent. Thus the notion of self-reflection on the self-formative process as a methodology of critical science, is of crucial importance in understanding the thought of both Habermas and Freire (*cf*. Habermas, 1971, p. 212).

This awareness of the self-formative process brings Freire to the power of words, the use and analysis of language. "To exist, humanly is to name the world, to change it. Once named, the world in its turn reappears to the namers as a problem and requires of them a new naming. Men are not built in silence, but in word, in work, in action-reflection" (Freire, 1970, p. 76).[10] Thus, naming the world creates the opportunity to transform the world. The interrelationship here is essential:

word=work=praxis. Action alone is mere activism. Reflection alone is verbalism (Freire, 1970, p. 75). Naming the world is not prescribing, not sloganizing, not naming _for_ another. It is done by the self-reflective subject and furthered by dialogue. It is not the right of a privileged few, but the right of everyone.[11] This is Freire's "theory of dialogics" which will be discussed within the context of emancipatory education that follows.

The Educational Context: Teacher-Student With Students-Teachers

Having defined the person-in-context, I will now turn to the educational process and develop the implications this view of the person has on Freire's educational praxis.

In analyzing the educational context, Freire defines the teacher-student relationship as having a fundamentally "narrative character." This relationship has the teacher as "narrating subject", and the students as "patient, listening objects". Whatever the _content_ of the narration, in the process of being narrated, it becomes "lifeless and petrified", and thus alienating (Freire, 1970, p. 56). The words used in the narration are powerless, meaningless and abstract. They lack the power of transformation. Memorization of isolated facts are deposited (the "Banking Concept" of education) within the object.[12] Teacher-students exist as contradictions, opposing forces. Slogans and "communiques" are handed down to the students. Communication is vertical. Emancipatory educational praxis seeks to reconcile the contradiction between teacher-students so that both are "simultaneously teacher _and_ student" (Freire, 1970, p. 58).

The teacher-student contradiction is resolved by breaking the vertical patterns of communication (anti-dialogic pattern

A

over

B = communique), and establishing a horizontal relationship (Dialogic A with B = communication/intercommunication) (Freire, 1973, pp. 45-6).

The banking concept of education is based on a distorted understanding of subjectivity and objectivity, i.e. the separation between acting subjects and objects of experience. Freire states that

> Implicit in the banking concept is the assumption of dichotomy between man and the world: man is merely in the world, not with the world or with others; man is spectator, not recreator. In this view, man is not a conscious being; he is rather the possessor of a consciousness: an empty "mind" passively open to the reception of deposits of reality from the outside world. For example, my desk, my books, my coffee cup, all the objects before me -- as bits of the world which surrounds me -- would be 'inside' me, exactly as I am inside my study right now. This view makes no distinction between being accessible to consciousness and entering consciousness. The distinction, however, is essential: the objects which surround me are simply accessible to my consciousness, not located within it. I am aware of them, but they are not inside me (Freire, 1970, p. 62).[13]

The educator's role within the banking concept is that of one who regulates "the way the world 'enters into' students". He/she organizes the process of learning, and in a real sense, controls the learning process,[14] in order to make

> deposits of information which he considers to constitute true knowledge. And since men 'receive' the world as passive entities, education should make them more passive still, and adapt them to the world. The educated man is the adapted man, because he is better 'fit' for the world (Freire, 1970, pp. 62-63).

From the beginning to end, the process is in the control of the educator/teacher.[15] There are two stages to this process of planning for the learning situation. In the first stage, the educator "cognizes a cognizable object" while preparing lessons, and in the second stage the teacher lectures to his/her students concerning that object. The students receive these messages given by the teacher, and perhaps memorize them, but they are not called upon to "know", to actively engage in thinking. There is no need for students to practice any "act of cognition" because the object of cognition belongs to the teacher rather than being a "medium" which evokes critical reflection of both teachers and students. Thus, "in the name of 'preservation of culture and knowledge' we have a system which achieves neither true knowledge not true culture" (Freire, 1970, pp. 67-68).[16]

The notion of "objects of experience" as being media which evoke critical reflection, critical thinking on the part of both teacher and students emphasizes communication between teacher and students, and it is in communication (dialogue) that meaning is arrived at. Thus, the teacher's thinking is

> authenticated only by the authenticity of the student's thinking. The teacher cannot think for his students, nor can he impose his thoughts on them. Authentic thinking, thinking that is concerned about reality, does not take place in ivory tower isolation, but only in communication. If it is true that thought has meaning only when generated by action upon the world, the subordination of students to teachers becomes impossible (Freire, 1970, pp. 63-64).[17]

Hence, social reality (context) becomes the text-analogue for investigation (cf. Koetting, 1979, Chapter II). However, Freire's intent here is to go beyond intersubjective understanding (meaning; Verstehen). His pedagogy is action-oriented, i.e. meanings must lead to "taking action on" the new meanings. If no action is taken, we are left with "mere verbalism". Yet intersubjective communication, mutual understanding is essential in that it is necessary for emancipation.

The notion of teacher-student with students-teachers is important in understanding the social relations of the educational context and also in understanding the emancipatory intent of Freire's pedagogy. Traditionally, the idea of teacher-students has established a contradiction (tension) in the way that education is understood. The notion teacher-students establishes authority/power wherein a teacher is viewed as having knowledge and therefore "teaches" people (students) who do not have that knowledge. The banking concept of education is quite clear here, and how a teacher prepares for teaching is clear also. The instructional design model, as a means of organizing the instructional process, would be effective in this view of education. Freire refers to this process as "anti-dialogic" because it establishes a vertical pattern of communication.

A

over

B = handing out communiques.

This contradiction (teacher-students) is resolved by establishing a horizontal relationship/pattern of communication within the educational context: A with B = communication/intersubjective communication. This is the dialogical model. The social relationships within this context are seen as teacher-student with students-teachers, meaning that the teacher

> is no longer merely the one-who-teaches, but one who is himself taught in dialogue with the students, who in turn, while being taught also teach. They become jointly responsible for a process in which all grow. In this process, arguments based on 'authority' are no longer valid; in order to function, authority must be on the side of freedom, not against it. Here, no one teaches another, nor is anyone self-taught. Men teach each other, mediated by the world, by the cognizable objects which in banking education are 'owned' by the teacher (Freire, 1970, p. 67).

Thus, in one phrase, teacher-student with students-teachers, Freire has radically altered the conceptual understanding of social relationships within the educational context. In re-naming the subjects involved in the context, the context can be transformed. In order for the transformation to take place, however, subjects within that context must act on the new understandings, the new meanings. The praxis is inseparably inherent in the theory.

Problem-Posing Education and Consciousness

Imposing "knowledge" from above (depositing communiques), pre-packaging reality to be learned by students is the form learning takes in the scientifically-oriented view of education. The starting point in emancipatory education is the "problem-posing" view, i.e. the situation involved in the learning process is posed to the subjects as problematic. Thus, not only is consciousness of "objects" a focal point, but consciousness turned in upon itself (self-reflection) and the subject's relationship to the "objects" and its own awareness, results. This greater awareness of self in relation to what is being learned is emancipatory praxis. "Acts of cognition" are the aim, not "transferral of information" (Freire, 1970, pp. 66-67). It is thus through dialogue that the new relationship of teacher-student with students-teachers is formed.

Since, in this view, the person is not seen as the absolute center of consciousness (recognizing the social determinants of consciousness), emancipation comes from a critical awareness of one's context, and taking action on that awareness (praxis), mediated by the world (context). Problem-posing education, as a method, insures constant re-formation of reflections by the teacher-student. Students-teachers, no longer passive recipients of communiques, are now seen as "critical co-investigators in dialogue with the teacher" (Freire, 1970, p. 68). The teacher-student constantly re-considers the "content" of dialogue as the students-teachers present their own interpretations and understandings.

> The role of the problem-posing educator is to create, together with the students, the conditions under which knowldge at the level of the doxa is superseded by true knowledge, at the level of the logos (Freire, 1970, p. 68).

And this leads to "emergence of consciousness" and "critical intervention in reality".[18]

The problem-posing praxis of education uses the existential context of the subject, the concrete historical-biographical context, as its starting point. Students-teachers develop their "power to perceive critically the way they exist in the world with which and in which they find themselves; they come to see the world not as a static reality, but as a reality in process, in transformation" (Freire, 1970, p. 71). The relationship between theory and praxis is drawn into focus when the subject becomes aware that his/her perception of him/herself in context influences his/her action within that context.

Problem-posing education has no set systematized body of knowledge to be "handed down" or "distributed to" students. Knowable objects - always contextually based - mediate the teacher-student, students-teachers as subjects within the learning process. The dialectical relationship of these subjects is established in dialogue. It is the subject's perception of context (knowledge object) that is brought forth in the dialogue and open to critical reflection.

It is only within an educational context that "allows for" the subject's interpretation of his/her reality (context) that emancipatory education can take place. The form of presenting that interpretation will be addressed later in this paper. The important understanding at this point in my discussion is that when the subject is given opportunity to present his/her view or interpretation of reality, this interpretation is open to critical reflection through dialogue. In a scientifically-oriented view of education, the subject's interpretation of reality is usually not addressed, or, if it is, the questions asked by teachers are so structured that very specific answers are required, and if the student does not respond with answers that "fit" the questions with predetermined "right" answers, the student is "wrong".

The rightness/wrongness of responses to questions, although perhaps legitimate within a scientifically-oriented model of education, is a simplistic reduction of the learning process when the notion of Verstehen is introduced. When the method Verstehen is acknowledged as a valid form of reasoning (cf. Koetting, Chaper II), rightness/wrongness can only be determined in terms of adequacy and accuracy of interpretation, which allows for, or acknowledges, diverse expression. Diverse expression of responses to questions needs critical analysis of those responses, and hence the need for a critical science. Critical science has its roots in dialogics and "critical thinking" which are characteristics of emancipatory educational praxis.

Theory of Dialogics and Critical Thinking

For Freire, dialogue is the "encounter between men mediated by the world, in order to name the world" (Freire, 1970, p. 76). There are certain conditions required of subjects who enter into dialogue:

1. a profound love of men
2. humility
3. an intense faith in man (this is an a priori faith in the person)
4. trust (established through dialogue)

5. hope (rooted in the person's incompleteness, and recognition of that incompleteness; constant search)
6. critical thinking (Freire, 1970, pp. 78-82).

These requirements demand total commitment to the process of dialogue from those who choose to enter into the dialogic relationship. They are neither naive nor unworkable. They become, for subjects engaged in emancipatory praxis, a basic orientation to life.

The term critical thinking, as a necessary element in dialogue, needs to be pursued and delineated further. Critical thinking is thinking which

> discerns an individual solidarity between the world and men and admits of no dichotomy between them -- thinking which perceives reality as process, as transformation, rather than as static entity -- thinking which does not separate itself from action, but constantly immerses itself in temporality without fear of the risks involved. Critical thinking contrasts with naive thinking, which sees 'historical time as a weight, a stratification of the acquisitions and experiences of the past', from which the present should emerge normalized and 'well-behaved'. For the naive thinker, the important thing is accomodation to this normalized 'today'. For the critic, the important thing is the continuing transformation of reality, in behalf of the continuing humanization of men (Freire, 1970, p. 81).

Dialogue requires critical thinking and is capable of generating critical thinking. Communication is based on dialogue, and education is based on communication. Communication is concerned with meaning, understanding. Relating this notion to Habermas' theory (1971), the practical interest of arriving at mutual understanding is in evidence. Relating understanding to critical thinking and interpretation roots emancipatory education in the critical sciences. In the critical sciences, the paradigm for knowledge is no longer the "observation" but the "dialogue" (Habermas, 1973, p. 11).[19]

When both teacher and students address their "act of cognition" to the mediating object, then the contradiction between them is able to be resolved. Thus,

> the dialogical character of education as the practice of freedom does not begin when the teacher-student meets with the students-teachers in a pedagogical situation, but rather when the former first asks himself what he will dialogue with the latter about. And preoccupation with the content of dialogue is really preoccupation with the program content of education (Freire, 1970, pp. 81-82).

Within an anti-dialogic model (e.g. banking education, scientifically-oriented education, the instructional design model), the question of curriculum content is seen as program-content which the teacher will present to his/her students. In organizing the program for study, the teacher, in essence, has designed and answered his/her own questions concerning that content. Within a dialogic model (problem-posing, teacher-student with students-teachers), program content of education is neither a gift nor an imposition (i.e. bits of information/data), but rather the "organized, systematized, and developed 're-presentation' to individuals of the things about which they want to know more" (Freire, 1970, p. 82). Thus, the teacher's role is to "dialogue" with students-teachers about their view of the world, rather than impose their own view on them. The teacher-student must realize that the students-teachers' view of the world, manifested by their action, reflects their "situation in the world" (cf. Freire, 1970, p. 85). In order to determine the curriculum content of education, we must turn to the reality which "mediates" individuals, and to their preception of that reality as held by teachers and students (cf. Freire, 1970, p. 86). This is a radically different view of the educational process than that found in the instructional design model (e.g. Kemp, 1977; Banathy, 1968; Gagné and Briggs, 1974, etc.), wherein the process itself is pre-planned by the teacher, with minute, specified outcomes, and the emphasis is on the final product structured according to those stated outcomes. The instructional design model does not admit of, nor allow for varying interpretations of symbols, much less critical analysis. There is no need for critical analysis when ends are very specifically defined.

The individual's perception and articulation of reality that "mediates", or intervenes in their lives becomes the "subject matter" for analysis when re-presented to the individuals and posed as a problem. This reality needs to be seen as a problem before it can be acted upon and the context transformed. The context cannot be transformed until subjects understand that they have the capacity to intervene in their own context and change that context. They then need to take action on their understandings (cf. Freire, 1973, p. 48).

Curriculum Content: Thematic Universe and Generative Theme

In the dialogic theory of action, where subjects meet in cooperation "to transform the world" (context), all are responsible for curriculum content. This content is based on the "thematic universe" of students-teachers. The thematic universe represents the students-teachers' "preoccupations" within their context, the "things about which they want to know more", and also their perception of that context. These themes are "organized, systematized, and developed", and then "re-presented" to them posed as problems (Freire, 1970, p. 82).

The form this process takes would begin with the problem-posing context.[20] This means asking questions and also "calling into question". It is an unmasking of "social constraints" and, going a step further, questioning the reasons why those constraints exist. This is accomplished by constructing "generative themes". A generative theme, based on students-teachers perceptions of their world, established through dialogue, could be concepts, phrases, works, etc., that are chosen and analyzed in two stages: codification and decodification.

The first stage, codification, consists of re-presenting the "object of reflection" to the subjects in a form identifiable to them, and related to their experience. For example, Freire used photographs and drawings depicting the existential situations of the people with whom he worked. The visuals used were familiar to his subjects because they contained situations and events based on the subjects' own descriptions of their life-situations. These "codified" visuals become the objects that mediate the subjects in their critical analysis. the codifications become "cognizable objects, challenges towards which the critical reflection of the decoders should be directed" (Freire, 1970, p. 107). The cognizable objects (visual re-presentations of the subjects in life-situations), posed as problems to the subjects, depict the situationality of the subjects. Self-reflection upon this situationality is reflection about the very "condition" of existence, namely, "critical thinking by means of which men discover each other to be 'in a situtation'" (Freire, 1970, p. 100). When this situation (context) is seen as an "objective-problematic situation", subjects reach the stage wherein the ability to intervene in their self-formative, historical context becomes a possibility.

> Intervention in reality -- historical awareness itself -- thus represents a step forward from emergence, and results from the conscientizacao of the situation. Conscientizacao is the deepening of the attitude of awareness characteristic of all emergence (Freire, 1970, pp. 100-101).

The second stage of analysis, decodification, consists of teacher-student, students-teachers reflecting critically (dialogics) on the mediating objects (e.g. visuals) thus externalizing their "thematics" and consequently making "explicit" their "real consciousness" of the world

(Freire, 1970, p. 108).[21] During this time, through dialogue, interpretations are challenged and understandings questioned, constantly posing the object of discussion as problematic. Through this process, which Freire refers to as "conscientization", subjects can arrive at a greater awareness of the social context which forms their lives, and also create awareness of their capacity to intervene and transform it.[22]

The process of decoding the mediating objects under analysis thus consists in investigation of the subjects' thinking concerning their life-situation. Thematic investigation, which deepens historical awareness, becomes educational. At the same time "all authentic education investigates thinking" (Freire, 1970, p. 101). Investigating the subjects' thinking leads to further investigation, hence education and thematic investigation are "simply different moments of the same process" (Freire, 1970, p. 101).

When subjects begin to make explicit their views of the world, they begin to see how "they themselves acted while actually experiencing the situation they are now analyzing, and thus reach a 'perception of their previous perception'" (Freire, 1970, p. 108). Achieving this awareness, reality is perceived differently: "By broadening the horizon of their perception, they discover more easily in their 'background awareness' the dialectical relations between the two dimensions of reality." Thus the process of decodification brings about new perceptions and the development of "new knowledge" (Freire, 1970, p. 108).

The Subject as Praxis

Through this learning process, the subjects involved are praxis --

> the praxis which, as the reflection and action which truly transforms reality, is the source of knowledge and creation . . . It is as transforming and creative beings that men, in their permanent relations with reality, produce not only material goods --

> tangible objects -- but also social institutions, ideas and concepts (Freire, 1970, p. 91).

Thus, as beings who are praxis, the individual, in contrast to all other creatures, can "emerge from the world, objectify it, and in so doing, can understand it and transform it with their labor" (Freire, 1970, p. 119).

Reflection, and subsequent action on understandings arrived at through reflection, leads to the possibility of emancipatory educational praxis. Individuals within this emancipatory model become responsible for the direction of their lives, and play a major part in determining the content under investigation. Basic literacy skills take on the dimension of giving power to individuals in controlling their destinies, giving them access to "information" previously excluded from their experience.

Freire's concern in emancipatory education is based on transformation of the world (context) through praxis. His praxis (action) is "informed" and inseparable from theory. Verbalism or activism results in separating this relationship. At the center of this view of educational praxis are epistemological issues. Reflection and critical thinking become modes of inquiry into the situationality of life. Freire thus allows for, or acknowledges as legitimate, alternate forms of inquiry into social settings. A radical positioning of the subject within a context over which the person can "gain control", to unmask seeming constraints and make decisions that transform that context, is based on critical thinking, critical consciousness.[23] Critical thinking, subjective knowledge, truth, "authority", the very concept of knowlege, are clearly embedded in Freire's view. These are epistemological issues that Habermas' theory of knowledge and interest (1971) brings into clearer focus.

Discussion

Freire's view of education, based on critical consciousness, critical thinking, the capacity to transform social context, the theory of dialogics, etc., necessarily focuses on communication between teacher-student, students-teachers, and also personal interpretations of students-teachers' life-situations. These situations, posed as problems, can be critically analyzed, new understandings and interpretations arrived at, and possible action taken on those understandings and interpretations.

The value of Freire's framework lies in his view of the learner, his emphasis on critical awareness of life context, his belief in the capacity of subjects to take an active part in changing that context, the manner in which curriculum content is determined, and Freire's seeing as valid (and yet open to critical analysis) subjects' personal interpretations of their world. These are the very points that others have been critical of Freire's view of education (cf. for example, Stanley, 1978 and Berger, 1976).

Stanley's (1978) critique of Freire's view of education is posed in the form of two problems: the problem of utopianism, and the problem of unanticipated social consequences. I would like to explore each of these problems in turn.

The Problem of Utopianism

According to Stanley, utopianism is evident in Freire's uncritical tendency to view the notion of literacy as the "key to liberation and a life of rational action for all persons. This is to say that he does not apparently take much note of the complexities, much less the dark side, of the notion of liberation itself" (Stanley, 1978, p. 227). The notion of liberation/emancipation contains certain ambiguities that Freire has not dealt with. In what way does consciousness contribute to the subject's making his/her own world and controlling his/her own context? Is not literacy, the notion of "naming the world in order to transform the world", too simplistic and insufficiently explicated by Freire in order to legitimate his emancipatory model of education?

To make a simple equation of "literacy education + critical consciousness = liberation" reduces Freire's complex view of education to an input/output view. There are no "guarantees" in Freire's view that emancipation of the subject will result. The subject must take action on his/her new understandings and hence bring about personal liberation. It cannot be done for the subject by anyone other than the subject. What Freire states, however, is that in personalizing the world, in naming the world, in becoming aware that social structures are not rigidified and "the way things are", the possibility for personal change, and hence social change is increased. the creation of culture according to subjects' view of society is in the hands of those who make up that culture. What is thus "non-utopian" in Freire's view is the political nature of education, and the resultant impact critical consciousness can bring to bear on that awareness:

> Irrespective of its most obvious functions such as the sorting out of children into occupational categories and teaching curriculum, the essential feature of schooling according to Freire, is the formation of a child's consciousness. His perception of himself and the world in which he lives, his ability to act upon, to control and to transform the social world are developed within the school. The organization of knowledge and the particular pedagogical relationship which it entails and utilizes becomes political elements in a system of social control. Thus the economic and political power of the dominant classes is converted through education into the individual's self and social awareness. Through his analysis of traditional forms of 'banking education', Freire contributes to the argument about how cultural hegemony may operate through schooling, and puts forward the possibility of forming a counter hegemony through education (MacDonald, 1977, p. 81).

The relationship between literacy and action, according to Stanley (1978) also contains the possibility of latent elitism:

> He who believes himself to understand the dimensions of true consciousness, whatever they are, must necessarily -- however temporarily -- play the role of an elitist guiding the unenlightened to their proper destiny. Freire's views . . . place an extraordinary emphasis upon education as an instrument of liberation (pp. 228-229).

This criticism of the latent elitism in Freire's thinking is more forcefully stated by Berger (1976). Berger's critique sees in Freire's writings a "hierarchy of consciousness" wherein cognitive "superiority" is established: "The cognitively superior individual is, by virtue of his consciousness, at a higher level of freedom, and thus of humanity" (pp. 124-125). Berger's thinking rests on the notion of "information," i.e., if we talk in terms of information that a person has in comparison to another, then, indeed, a hierarchy can be established. For example, a teacher has a specified body of information that he/she teaches to students who supposedly do not have that information. Yet students also have a body of information. They are not vessels to be filled (deposits). It is not a question of quantity or quality. I believe Berger misinterprets Freire's notion of expanded consciousness. Freire is not concerned with a "cognitive hierarchy". He is concerned with the subjects understanding of, perception of, and interpretation of his/her world (context). In critically analyzing these understandings, perceptions and interpretations, the intent is to pose these views as a problem and bring them to the consciousness of individuals so that action (cultural action for freedom) can be taken on these understandings. It is in the action taken that the possibility for emancipation from constraints can be brought about.

I need to point out also that in determining curriculum content, within Freire's view of teacher-student with students-teachers, all share in the development of that curriculum. The teacher-student has the right to "pose as problematic" existing reality, to question and "call into question" views and interpretations of reality, and this holds equally for students-teachers. This is so because educational content is dialogical. Hence the teacher-student also has the right to "participate by including themes not previously suggested" (Freire, 1970, p. 114).[24] The theory of dialogics as outlined by Freire cannot be practiced by a person who perceives him/herself as "cognitively superior" to the subjects with whom they interact. Reviewing the characteristic of dialogics (cf. Freire, 1970, pp. 78-82), if these features become part of the dialogic event, an elitist or superior attitude can be minimized. This admits that feelings of superiority may arise, but viewed within an overall framework of emancipation and validity of personal knowledge subject to critical analysis, the dangers of elitism can be lessened. Thus, the potentiality for elitism in Freire's "rhetoric" (as Stanley claims) is indeed a danger, yet the characteristics of true dialogue as outlined by Freire work toward eliminating that danger.

The Problem of Unanticipated Outcomes

The second problem with Freire's thought raised by Stanley is the problem of unanticipated outcomes, i.e.

> Freire does not go far toward exploring the practical implications of his literacy program for the larger orders of society and culture. Without benefit of such sociological extrapolation of possible consequences, there is much risk in heeding the call to cultural revolution (Stanley, 1978, p. 230).

Stanley states, for example, that Freire's sense of literacy education will not mean the same thing for all people. Thus, the profound energies unleashed by emancipatory education could bring about destabilization and the "recapitulation of past forms of oppression" (Stanley, 1978, p. 231).

The unanticipated outcomes, whatever they might be, need to come about if the underlying assumptions of Freire's view of education are accepted as valid. The inability of Freire's view to predict all the social outcomes and ramifications is not a limitation of the view itself, but a limitation if seen within a world-view of scientifically-oriented, empirical model of the educational process. Thus acceptance of Freire's view contains a notion of ambiguity of outcome. Results within his view cannot be totally predicted without destroying the emancipatory intent. If we could control outcomes, we would have an empirically verifiable process of education. Yet this is clearly not Freire's view. A willingness to accept such ambiguity of possible outcomes is necessary if Freire's model is accepted and put into practice.

"Naming the world", as a step toward literacy education within Freire's model, a step toward world interpretation and creation by students-teachers, is a personal activity that has social implications. How individuals perceive their world and communicate that perception influences behavior. Learning to "read and write", i.e. to communicate, goes beyond simple "word recognition" and "reproduction" of existing symbols.

> Either one stays on the side of operationally defined efficiency standards of literacy or one makes one's way to a larger view of what literacy means. In that case one finds oneself well beyond the confines of technical definitions; one is in the domain of social and political philosophy . . . sooner or later one must opt either against a status quo or for it and its possibilities. To do neither is to default on one's freedom of decision by becoming a literacy technician at the service of the highest bidder (Stanley, 1978, pp. 218-220).

A non-technical conception of literacy education, and more generally for my purposes, of education, can be seen when literacy (education) is not treated simply as a "ultilitarian technique but as a composite of skills oriented to the achievement of a certain quality of personal consciousness (Stanley, 1978, p. 220). Critical understanding of the world, and the subjects life within that world, is of utmost importance in the daily living-out of existence.[25]

In view of my paper thus far, Freire's emancipatory model of education takes into consideration the personal interpretation of the world by students-teachers. These views are seen as valid regarding forms of knowledge about the world. Yet the dimension of critical thinking, critical consciousness, as a form of rationality, a way of arriving at personal knowledge, poses these interpretations as problematic. There is no one interpretation that is the valid interpretation. The learning experience thus cannot be pre-packaged for students. There are only possible interpretations, and these are open to critical analysis. The existing world, and teacher-student, students-teachers view of that world become the starting point for knowledge. What is to be learned, even within existing curricula, is thus determined by the teacher-student with students-teachers. The critical issue here is to begin to develop ways in which students-teachers can become involved in the planning process. Freire's framework offers a radical alternative (interpretation) to existing forms of education. His position may indeed be regarded as "utopian". Yet those who dismiss Freire's view in that it is

> Naive and unrealistic, might perhaps consider the substance of the nature and faith upon which their own optimism and idealism rests. For to argue that his views are acceptable in theory but not in practice is to admit one's own failure to exercise control over such relationships (Denis Gleeson, as quoted in MacDonald, 1977, p. 85).

In Freire's emancipatory model there is no complete knowledge as such, but rather a "knowledge object" that mediates teacher-student and students-teachers as subjects in the knowing process. Dialogue, i.e. the theory of dialogics thus establishes the epistemological relationship between these subjects in the knowing process (cf. MacDonald, 1977, p. 83). Although there are no complete "bodies of knowledge" as such, there are many sources of information that can be brought to bear on the learning process, along with students-teachers' interpretations and views of reality. Educational media can provide those various sources of information. The final section of this paper will point to the implications and conceptualization of educational technology as they relate to the learning process that I have discussed thus far. I will argue that the field of educational technology has much to offer education within the framework of Freire's model of emancipatory education. This will demand, however, a re-thinking, a re-conceptualizing of the basic concepts used in educational technology, and will necessarily emphasize students-teachers' production of materials as valid interpretations of their view of reality for analysis within the learning context.

Part II: Implications and Discussion of Freire's Emancipatory Model for the Field of Educational Technology

In this section of my paper I want to continue constructing an argument for the necessity of expanding the conceptual base for the field of educational technology. I want to expand the theoretical base, which is essentially behaviorist theory, to include alternative forms of rationality. This section will also make explicit the implications for educational technology that I see within Freire's emancipatory model of education.

I have presented one possible alternative framework of schooling, a framework which I believe begins to address complex issues in the field of education generally, and the field of educational technology in particular. Within the area of educational technology the dominant, accepted theoretical base for understanding education is the behavioral framework. To expand this theoretical base will necessitate reconceptualizing our underlying views and assumptions about education in order to incorporate more radical and divergent views other than those commonly accepted (i.e., the scientific, behavioral view of schooling). If I acknowledge and accept that there are alternative modes of rationality other than the empirical mode (cf. Koetting, 1979; Habermas, 1971, MacDonald, 1975a, Eisner, 1979), then I acknowledge and accept that those involved in inquiry are capable of making valid knowledge claims, yet these claims are open to analysis and critique. Thus the limited view of the subject (learners) in behaviorist theory (reactive agent to stimuli) is expanded to an active subject capable of engaging in inquiry.

Freire's emancipatory model of education provides us with an alternative conceptual framework for viewing schooling. His views are radically divergent from those commonly held within education generally. The value of Freire's model lies in his understanding of the "subject-in-context" (a critical concept in educational technology in need of reconceptualization), his notion of critical thinking (critical reflection on individual circumstance/context), the subject's capacity to transform his/her context, and the organization and decision making regarding curriculum content. Seeking knowledge about one's self and/or the world, and most importantly, one's relationship to that world, for Freire is thus a very active process, as opposed to the passive, or re-active process of behaviorist learning theory.[26] Freire's view not only acknowledges diverse modes of rationality, but from the point of view of chosing curriculum content, allows for the students-teachers' view to be accepted as legitimate, yet open to critical analysis.

In the remainder of this paper I will be concerned with providing one possible alternative interpretation (direction) and reconceptualization of certain underlying assumptions of the field of educational technology. My emphasis will be on the notion of knowledge vs information, the subject-in-context, educational media[27] as sources of information and tools of communication for curriculum development and evaluation of the instructional process, and the notion of emancipatory educational praxis.

The Need for an Expanded Theoretical Base in Educational Technology

The need for an expanded theory-base in educational technology is related to the underlying assumptions mentioned above. The behavioral theory-base of educational technology is a limited view of education and places limitations on how one generates/arrives at knowledge, how the subject is understood, and how curriculum is organized for instruction. Educational technology relies heavily on this one mode of rationality (behaviorist theory). The very nature of behaviorist theory structures the learning situation to insure learning of information. The subject is reduced to a re-active agent in the learning situation, and curricula are pre-packaged and determined by "experts". There are alternative views of education other than that found in the behaviorist tradition. Behaviorist theory is one possible interpretation. Yet our field has accepted behaviorist theory as the only theory for using media in education.

The behavioral model is reductive, i.e. it takes a very complex social reality (viz. education) and oversimplifies this reality by operationalizing the notion of information,[28] and structuring the learning environment in such a way that incremental "knowledge" can be attained and measured. Thus certain students receive certain treatment(s) so that certain behavior(s) will result. This model does not acknowledge self-reflection (interpretive understanding) or critical analysis. "Knowledge" (information) has been pre-determined, and there is no allowance for deviation from predefined answers. The behavioral model (e.g. instructional design model) has a constitutive interest in control (cf. Koetting, 1979, Chapter III). A control model applied to education is an inadequate model when understanding of human behavior is our intent. A control model limits the possible responses that students-teachers can make when pursuing knowledge.

An expanded theory-base will allow the field of educational technology to stay in the main current of educational theory. This would, at one end of the continuum, keep us rooted in the behaviorist tradition, and at the other end of the continuum, open the possibilities for dialogue with colleagues in academia who are working in a humanistic, or more radical framework of education. An expanded theory-base would thus be of primary importance to university/college instructors in colleges of education, and media specialists at the local level, who daily work with teachers with diverse philosophies and frameworks of education.

The Thought of Paulo Freire: Basis for Reconceptualizing Theory

One option for reconceptualizing the underlying views and assumptions in educational technology that I have argued need to be reconceptualized lies in Freire's emancipatory model of education.[29] Freire's view of knowledge regards the subject as being active in the pursuit of knowledge, capable of engaging in dialogue and having valid perceptions and interpretations of the world. This view of the subject stands in opposition to the view of the "learner" in behaviorist theory, wherein the learner is, in reality, a passive receptor of information that has been "programmed" for him/her. The subject for Freire is capable of valid reasoning and interpretation, and at the same time the subject's views are open to critical analysis, which is carried out in the dialogic relationship.

Knowledge within Freire's view is arrived at through diverse forms of inquiry. "Knowledge" (information) within educational technology is arrived at through inquiry that has a constitutive interest in control. This form of inquiry, rooted in behaviorist learning theory, is inadequate as the sole method of investigation for a field of study that must concern itself with symbol systems. Symbols are subject to interpretation, not "right or wrong" meanings. Meanings are determined through interpretive understanding (cf. Koetting, 1979, Chapter II), and various interpretations can be viewed as valid. Critical analysis and critical argument establish the accuracy and ultimate validity of interpretation, and this is not based on "authority" but on reasoning and critical thinking.

The instructional design model used in educational technology, by its very nature has a constitutive interest in control of the process of inquiry. In this model, what is acceptable as "right/wrong" responses is determined and defined prior to teaching. Thus, there is no room for personal interpretation on the part of students-teachers that is contrary to preconceived definitions of the "knowledge" (information) that is to be gained through instruction. The scientific-rationality of certitude of outcomes is the important understanding here, and if it is not forth-coming, if the end result (product) does not match the stated objectives, then the system is faulty and needs to be re-structured. The teacher-student who uses this model operates on the assumption that a "right" system can be devised through the manipulation of variables and the control of environmental factors.

Media as Sources of Information

The importance that the utilization of media has at this point in my discussion lies not in viewing media as a source of "knowledge" that needs to be assimulated by students and then in devising a test to measure the success of that venture. Rather, we need to view media as sources of information that need to be brought to bear on the learning process and to be analyzed and critiqued for the particular interpretation of reality (viewpoint/statement) it represents. This is accomplished through questioning and "calling into question," through interpretation and analysis, and not through preconceived answers that are either "right/wrong", e.g. objective-type tests that ask questions which are answered correctly/incorrectly concerning specific information contained in the particular media presentation. Thus interpretive understanding and critical thinking become the methodologies of inquiry.

The Organization of Curriculum Content

The instructional design model, as a means of organizing the learning process, has a constitutive interest in controlling that process. Control is constitutive of the model itself, the nature of the model. The instructional developer (teacher) makes all the decisions regarding the organization and planning of the learning process, and this is done usually prior to meeting students who will undergo the instruction. One primary legitimating factor for using this "systematic approach" to designing instruction is the objective nature of the results planned for. Yet methods of inquiry have constitutive interests. (cf. Habermas, 1971). Empirical methodology has an interest in control. This is verified in praxis by exmaining the instructional design model and programs that have been designed according to the model. Knowledge is predetermined, right/wrong answers are predetermined, evaluation measures are predetermined, what students will "think, feel and learn" is predetermined, by someone other than the students.

The major difficulty with applying a control model to the learning process is centered on questions that point toward the "non-neutrality" of education: "Whose knowledge is it? Who selected it? Why is it organized and taught in this way? To this particular group?" (Apple, 1979, p. 7). Linking these questions with the emphasis on standardization of methodology and outcomes that is characteristic of the instructional design model, and the model's emphasis on control of the learning process (cf. Koetting, 1979, Chapter III), any deviation from predetermined outcomes cannot be considered. Thus all students who go through the structured learning activities of the model are expected to arrive at the same point (input-output model). This is a rather reductionist and simplistic view of education that poses strict limitations on what is determined "legitimate knowledge", and how one arrives at legitimate knowledge.

If I look at alternate forms of rationality (other than the empirical-behavioral form), I can arrive at knowledge through interpretive understanding (Verstehen) and critical science (Habermas, 1971). As I mentioned earlier, in working with symbol systems, e.g. in analyzing the language of film, the language of video, the language of photography, visual imagery, etc., I am situated in another mode of rationality, I am looking for interpretive understanding. When these interpretations are open to critical analysis, I am situated in yet another mode of rationality, that of critical science, critical thinking and analysis. The behavioral model of education does not use/recognize interpretive understanding or critical thinking as methodology.

The theory base for the instructional design model flows from an operationalized understanding of knowledge, a view of the "learner" as passive ("re-active"), a status quo view of society and culture, and an empirical means for evaluating outcomes (testing). Freire's emancipatory model/view of education has a theory base rooted in his understanding of the subject as active in the learning process (critical thinking), the understanding that social structures are made by people and hence changeable, the validity of individual interpretations of reality, and the problem posing view of education carried out through dialogue. Thus, in Freire's model, through the dialogic relationship established within the classroom, the teacher-student with students-teachers are responsible for "program content".[30] To talk about the organization of curriculum for instruction is to talk about theory. The relationship of theory to praxis is inseparable.

Within the emancipatory model, students-teachers' involvement in the organization and planning of curriculum content is thus insured from the very beginning. This notion of student involvement in the organization of content is a radical departure from the instructional design model which views responsibility for program content as the function of "knowledge experts" who work with instructional developers (who are usually the teachers themselves), who are working with a "value-neutral" model for organizing curriculum materials. As I argue elsewhere (1979, Chapters II and III), the instructional design model is not a value-free model. From beginning to end, the instructional design model has a constitutive interest in control of the learning process.

Paulo Freire's model of emancipatory education offers an alternative to the instructional design model used in educational technology. Recognizing that Freire developed his model for teaching adult literacy education to members of emerging countries, his ideas can still be most fruitfully applied to educational theory outside the framework of literacy education.

Freire utilizes interpretive and critical modes of rationality (Koetting, 1979; Habermas, 1971). Thus the subject within Freire's emancipatory model is viewed as capable of interpreting the world around him/her and at the same time, through unmasking constraints to emancipation (accomplished through dialogue, i.e. decodification) over which the subject can gain control in forming his/her context, and exercise the critical activity of changing that context.

Within Freire's model, responsibility for curriculum content becomes not the responsibility of authorities or experts, but is shared jointly by the teacher-student with students-teachers. Thus all members of the educational situation participate in developing content for instruction.

I need to examine alternative ways of organizing curriculum that would be consistent with Freire's model, ways that acknowledge students-teachers capable of having valid views of the world and at the same time recognizing that those views are open to critical analysis. One such alternative is the "presentation/production" model of organizing curriculum as presented by Morrow and Suid (1977). This model is relevant for my purpose here because it is rooted in the understanding that educational media can provide diverse sources of information that can be utilized in the classroom, and at the same time provide the means for personal expression and interpretation of individual students-teachers' views of their social context. The theoretical view of the nature of subjects and how they learn is important here, and is in general agreement with Freire's views as presented in this paper. Thus for Morrow and Suid, subjects (students-teachers) are most actively involved in the learning context from beginning to end.

Curriculum Development and Praxis

As Morrow and Suid (1977) point out in their opening chapter, people learn about their world and gather information about their world from a variety of sources. When this notion of "variety of sources" is applied to classrooms, these authors emphasize the use of media in the form of student-production. They tell us that students learn by doing, and that

> Experiences which actively engage our hands and eyes stay with us. Perhaps the true virtue of modern culture is the rich variety of media it affords for understanding and expressing ideas in the arts and sciences. Movies, radio, design, photography, print, and all the other communication forms are available to us not only as sources of information and pleasure, but as graspable tools for active, creative, and, ultimately, educational production (Morrow and Suid, 1977, p. 7).

The idea of learning by doing, and the notion that experience engaging our hands and eyes stays with us is not new.[31] Yet the notion of student-production of media as sources for learning is rather revolutionary in that it acknowledges media, other than print, as legitimate sources of information that can be used in classroom settings. It also accepts a view of the subject as having valid perceptions of his/her world upon which action is based. These perceptions can then become the basis for dialogue and critical analysis.

The notion of using diverse sources of information in the classroom expands the mode of communication in classrooms in both content area and the area of evaluation.[32] For example, a subject, theme, issue, or more generally, subject content, is the starting point for developing curriculum.

This starting point is the concern and responsibility of the teacher-student with students-teachers. Once the starting point has been determined,[33] the next question focuses on the sources of information that can be used in presenting information on the particular topic chosen. These sources are divided into design, print, photography, radio, movies, television and stage.[34] As Morrow and Suid (1977) suggest, however, the categories of media that they use need to be adapted by the individuals using the model. An important idea contained in their model is the awareness that various sources need to be examined that can be used to present as much information on the particular topic of discussion as possible.

Another important idea, or aspect, of their model is that of students producing materials that can be presented within that classroom that represent the students-teachers own views on the topic, and these views are open to formal reaction, or critical analysis.[35] Thus a form of Verstehen, or interpretive understanding is used in the production process, and also in the discussion and analysis of the student production. At the same time, discussion is carried on at the level of critical analysis of the production effort in terms of accuracy of interpretation and presentation of ideas.[36] When students-teachers work in particular media formats, they need to know the capabilities and "language" of the media they are using. In confronting any symbol system, Verstehen as methodology is used. In the analysis of production efforts, the methodology of critical science is used. In determining specific factual data or information learned from production efforts, the empirical mode of rationality can be emphasized. Three modes of inquiry can thus be applied within this model, and curriculum content can be determined by the teacher-student with students-teachers.[37] We are taken out of the adherence to the dominant mode of thinking in education (scientific rationality, or the behavioral mode) and also de-emphasizing the printed mode as the only mode of expression in the classroom. We can thus more adequately provide "equal access" to information for all students.[38]

Evaluation of "Educational Outcomes"

One important implication of accepting diverse modes of rationality and the use of media as diverse sources of information is that the notion of epistemological ambiguity will have to be recognized as part of the human condition, and that exactitude/certitude and/or predictability of outcomes does not adequately represent the total criteria for all forms of evaluating educational outcomes (as found in empirical science, and hence behavioral science). Educators thus need to look toward alternate and legitimate forms of evaluating educational outcomes. For example, Eisner (1979) suggests that the acknowledgement of epistemological diversity allows for evaluative activities that

> may be experienced in one mode and expressed by the student in another. For example, a student might read a short story and express what she has learned or experienced from it in a painting, film, or poem. Or, conversely, a student might see a film and express his reaction in a short story. Although such activities do occur at present, they are seldom created intentionally and are seldom based on a realization of the interaction between knowledge and performance systems. What I am suggesting here is that curriculum designers can intentionally exploit the variety of modalities humans use to conceptualize and experience the world and to express what they have learned about it (p. 129).[39]

Essentially, what Eisner is concerned with is that in the field of education, conceptually, there is a need to go beyond a control model of organization, inquiry and evaluation, to an intersubjective, emancipatory model of organization, method of inquiry and evaluation. This will involve diverse modes of rationality and organization, and allow for a variety of forms of education. This will also require educators to acknowledge that subjects (students-teachers) can have legitimate views of their world which can become the basis for critical analysis.

When subjects (students-teachers) become active participants in dialogue, i.e. in their own learning, self-reflection on their perceptions, and communicating those perceptions to each other become an important focus for activity. In communicating those perceptions to each other, both the self-reflective and critical components of rationality that are lacking in the behavioral/empirical model are evident and utilized here as means for arriving at knowledge in the educational setting.[40] Thus, in the educational setting, I need to accept one subject's perception as valid, just as I need to accept another's view, and they are all as valid as the teacher-student's view, and everyone within that setting can mediate the process through their own views and critiques.

Self-expression and communication of ideas within a non-scientifically oriented classroom will demand and allow for diverse modes of communicating those ideas. Thus, as there are diverse forms of knowledge, there are also diverse ways of expressing, communicating, learning and evaluating ideas and conceptions of the world. The teacher-student, as well as the students-teachers, need to determine what kind of knowledge they are seeking, and/or the nature of the knowledge they have arrived at.

Similarly, research methodologies applied to the educational setting need to be chosen with an understanding of the type of knowledge the researcher wants to attain in his/her investigation. For example, if I wanted to know

> the number of words a child can spell or the frequency of interaction between children of different races in desegregrated schools, then statistical procedures are appropriate. However, if we want to understand the relevance of the words to the child's

> particular life or the meaning of inter-racial interactions then some form of qualitative methodology [*e.g.* *Verstehen*] . . . which allows the researcher to obtain first hand knowledge about the empirical social world in question may well be more appropriate (Patton, 1975, p. 13).[41]

In other words, the empirical method of investigation would be an inadequate method of investigation to summarily investigate the social setting.[42] (*e.g.* life in classrooms), and/or problems within that setting (*e.g.* the nature of authority in classrooms, the control of knowledge in classrooms, the nature of school work, etc.). With emphasis on outcomes (ends), the process (means) becomes secondary, unless the outcomes have been correctly predicted, and then the means become standard treatment. If successful prediction and control of outcomes are our major aims, then the empirical method of investigation and the "scientific" organization of the subject matters would be acceptable. Yet the search for

> Objective control over the multiplicity of interdependent events occurring in a classroom has led to a concentration on ever smaller units of behavior, divorced from context and sampled in rigorously scheduled time units (Shapiro, 1973, p. 543).[43]

The emphasis on control of classroom learning is furthered by the extensive use of instructional (performance/behavioral) objectives, which are based on the notion of objective validity and the scientific rationality of empirical design (Koetting, 1979). Needing empirical measures and data to "prove" that students are learning, the teacher structures "objective" testing instruments which are easily quantifiable. Applying scientific rationality to the classroom insures at least outward control of the environment and the learning process. This has led not only to emphasizing the learning of factual data/information, but also to the notion of teacher competency and accountability, which is operationalized through competency-based teacher education programs in colleges and universities.[44]

Conclusion

Reconceptualizing basic underlying assumptions of educational technology will require a change in the present praxis in our field. The philosophical notion of knowledge as opposed to the operationalized notion of knowledge; the view of the subject as active participant in generating knowledge as opposed to the passive, re-active view in behaviorist theory; the joint responsibility of organizing instructional content as opposed to "knowledge experts" or instructional developers organizing instruction divorced from students' needs and interests; and the means of alternative evaluation procedures as opposed to "objective evaluation measures" based on performance objectives, are areas that I have discussed as needing to be reconceptualized if I accept Freire's emancipatory model of education.

Alternative modes of rationality (e.g. the empirical, interpretive and critical sciences) all need to be used in our educational settings in order to understand and personalize the context in which we live and find ourselves. Diverse sources of information, whether inside or outside the academic setting, need to be utilized to keep us informed about our world. Self-reflection and critical thinking are crucial means that need to be developed and utilized in school settings and seen as valid methods of inquiry. Epistemological ambiguity needs to be recognized not as reduction to relativism, but as a statement of understanding our predicament as members of human society. Exactitude and certitude are not always possible or desirable.

Our current practice in educational technology employs a control model of organization of the instructional process and an empirical model of investigation, based on performance objectives and evaluation procedures that measure factual information and data. There are alternatives to this view of educational technology. The teacher-student with students-teachers have to be aware of what knowledge they are seeking, with what intent they undertake their study, and the nature of knowledge at which they will arrive. We can thus rely less on data and information remembered, and work toward critical analysis, which demands self-reflection and critical thinking.

The emancipatory potential of utilizing media in education, as I have argued in this paper, is based on a reconceptualization of certin underlying concepts within our field, namely: the notion of knowledge as defined within a philosophical framework that sees as valid alternate forms of rationality; the nature of the subject-in-context; the organization of curriculum content and means of evaluating educational outcomes; and the utilization of media as diverse sources of information. These same forms of rationality need to be applied in the area of research in the educational setting. There are alternatives to our present theoretical base and praxis. The field of educational technology, which has a great diversity of means of presenting information, could truly revolutionize education that has as its intent, emancipation from constraints that hinder individual and social growth toward freedom.

Footnotes

[1] An important understanding at this point concerns the view of the subject ("learner") within the educational situation. In behaviorist theory, the learner is viewed as a reactive agent, i.e., one who responds (reacts) to stimuli presented to him/her (and one who does not initiate questioning). In a humanistic, or more radical tradition, such as Freire's framework, subjects are active within the learning process, that is, they are viewed as capable of having valid perceptions of their context (circumstance, world). These perceptions are open to critical analysis. Subjects create, rather than react to, situations that bring about knowledge. Thus critical thinking becomes the learning theory used to investigate/analyze the world. Consequently, critical thinking/analysis can be compared/contrasted with other learning theories, e.g. behavioral learning theory, gestalt-field theory, cognitive theory, etc. The important factor to examine in such comparing/contrasting is the analysis of the underlying assumptions of these theories as they relate to praxis (cf. my discussion in this paper under the heading Theory of Dialogics and Critical Thinking).

[2] Horkheimer, in Critical Theory: Selected Essays (New York: The Seabury Press, 1972), has stated that critical thinking (as part of the activity of critical science)

> is the function neither of the isolated individual nor of a sum-total of individuals. Its subject is rather a definite individual in his real relation to other individuals and groups, in his conflict with a particular class, and, finally, in the resultant web of relationships with the social totality and with nature (pp. 210-211).

[3] Apple, in Ideology and Curriculum (London: Routledge and Kegan Paul, 1979), cites the need for a part of the curriculum field to devote itself to the responsibility of becoming a critical science, whose "primary function is to be emancipatory in that it critically reflects upon the field's dominant interest in keeping most if not all aspects of human behavior in educational institutions under supposedly neutral technical control" (p. 122).

[4] For Freire, the relationship between theory and praxis is action-oriented. When the two are split, verbalism or activism result. Praxis is not merely a substitute for the term "practice". Practice denotes "what I do", or "what I should do", without any necessary reference to theory. Praxis, on the other hand, is inseparably related to theory.

[5] Freire's concern is with literacy education for the peoples of emerging countries. Generally, the oppressed people are wrapped in a "culture of silence" wherein "the metropolis speaks, the dependent society listens". The oppressed society receives from the dominant society a

> pre-processed and pre-digested reality, the major avenue of transmission of the reality-package being the educational system. In the case of the pre-processing of reality within the director society the communications media in general represent the major

source of transmission (cf. Barry Smart, Sociology, Phenomenology and Marxian Analysis, London: Routledge and Kegan Paul, 1976, p. 170).

[6] Horkheimer, Critical Theory: Selected Essays, op. cit., states it similarly:

> But there is . . . an essential difference between the individual and society. The world which is given to the individual and which he must accept and take into account is, in its present and continuing form, a product of the activity of society as a whole. The objects we perceive in our surroundings -- cities, villages, fields, and woods -- bear the mark of having been worked on by man. It is not only in clothing and appearance, in outward form and emotional make-up that men are the product of history. Even the way they see and hear is inseparable from the social life-process as it has evolved over the millennia. The facts which our senses present to us are socially pre-formed in two ways: through the historical character of the object perceived and through the historical character of the perceiving organ. Both are not simply natural; they are shaped by human activity, and yet the individual perceives himself as receptive and passive in the act of perception (pp. 199-200).

[7] In Education for Critical Consciousness (New York: The Seabury Press, 1973, pp. 3-5), Freire distinguishes between adaptation and integration to society. Adaptation reduces the person to an "object" of society; integration sees the person as "subject", who not only adapts to social context, but has the critical capacity to make choices and transform that context.

[8] In a behaviorally-based model of education, the concern is not with the self-formative process, or the formation of society, but rather with correct responses to pre-determined "knowledge", which is based on a fixed view of the social context and the necessity for the learner to adapt to, or "fit into" the existing social context.

[9] Also, cf. Joel Spring's A Primer of Libertarian Education (Montreal: Black Rose Books, 1975), especially Chapter three, "The Growth of Consciousness: Marx to Freire", pp. 61-80.

[10] Freire proposes that the learning context must present individuals with the possibility of reflecting upon the "process by which reality is apprehended" so that they can go beyond their original distorted understandings, i.e., beyond the seeming natural order of things (cf. Smart, Sociology, Phenomenology and Marxian Analysis, op. cit., pp. 170-171.

[11] cf. Arnold Wesker, Words as Definitions of Experience (London: Writers and Readers Publishing Cooperative, 1976).

[12] Freire's notion of the "banking concept" of education adequately describes the educational praxis that results in applying the instructional design model to the educational setting. See my discussion of the design

model, Chapter III, in Towards a Synthesis of a Theory of Knowledge and Human Interests, Educational Technology and Emancipatory Education: A Preliminary Theoretical Investigation and Critique (Unpublished Doctoral Dissertation: University of Wisconsin - Madison, 1979).

[13] Freire's description of the subject here is essentially a description of the "learner" within the behavioral model of education, i.e. a passive, re-active agent within the educational setting.

[14] Freire's view of the "teacher" within the banking notion of education defines the role of the teacher within the behavioral model of education i.e., the knowledge "expert". This is essentially the role of the instructional developer (usually teachers) within the field of educational technology.

[15] Although the rhetoric of description is forceful here (oppressor, oppressed, domination, etc.), there is a real sense in which these words describe the scientifically-oriented view of education, particularly with reference to objectives, the overall utilization of the instructional design model and the notion of "pre-packaged knowledge" (reality). There is no opportunity for creative input into the instructional program within this model, only minimal participation by way of responding to questions with limited and pre-specified answers. Also see Herbert M. Kliebard, Bureaucracy and Curriculum Theory, in William Pinar (ed.), Curriculum Theorizing: The Reconceptualists (Berkeley, California: McCutchan Publishing Corporation, 1975).

[16] It is not true knowledge or culture because it is only information, it doesn't belong to the subject, it is someone else's view of reality, i.e. what someone else calls knowledge and culture.

[17] Elsewhere, Freire extends the thought in the passage just quoted:

> At home, as husband and father, I cannot be the owner of my wife and children, nor at school, as teacher, can I be the owner of my students. I cannot 'enter' into their beings in order to move them toward the 'ways' which seem best to me. If I do so, I am their dominator and they are mere 'things' which I possess; dialogue and true love are impossible (Cultural Action: A Dialectic Analysis. Cuernavaca, Mexico: CIDOC, 1970. CIDOC Cuaderno No. 1004, as quoted in Paulo Freire: A Revolutionary Dilemma for the Adult Educator. Stanley M. Grabowski, ed. ERIC Clearinghouse on Adult Education, Syracuse University, 1972).

[18] The students-teachers, in presenting their own interpretations and understandings of their "context", are naming their reality, as they perceive it. For Freire, "naming" reality has a "creative and transformative" connotation. Anyone standing in the way of "humanization", whether consciously/unconsciously, becomes, in Freire's use of the term, "the oppressor". See Manfred Stanley, The Technological Conscience, op. cit., p. 225. Also cf. Arnold Wesker, Words as Definitions of Experience, op. cit.

[19] Habermas goes on to say that the dialogue is thus "a communication in which the understanding subject must invest a part of his subjectivity, no matter in what manner this may be controllable, in order to be able to meet confronting subjects at all on the intersubjective level which makes understanding possible" (Habermas, 1973, p. 11). Yet critical theory seeks to go beyond the contents of "cultural tradition". It is critical of "ideology" and asks what lies behind the consensus that is now arrived at and presented as fact? What is it that supports the dominant tradition, and does so "with a view to the relations of power surreptitiously incorporated in the symbolic structures of the systems of speech and action?" See Jürgen Habermas, Theory and Practice (Boston: Beacon Press, 1973), pp. 11-12.

[20] Denis Goulet, in his introduction to Freire's Education for Critical Consciousness, op. cit., draws the distinction between Freire's notion of problem-posing education (wherein the natural, cultural and historical reality in which the subject is immersed is seen as "problematic") and the "problem-solving" view of education, wherein

> An expert takes some distance from reality, analyzes it into component parts, devises means for resolving difficulties in the most efficient way, and then dictates a strategy or policy. Such problem-solving, according to Freire, distorts the totality of human experience by reducing it to those dimensions which are amenable to treatment as mere difficulties to be solved. But to 'problematize' in his sense is to associate an entire populace to the task of codifying total reality into symbols which can generate critical consciousness and empower them to alter their relations with nature and social forces (p. IX).

[21] Freire, Pedagogy of the Oppressed (New York: The Seabury Press, 1970) states that

> In all the stages of decoding, men exteriorize their view of the world. And in the way they think about and face the world -- fatalistically, dynamically, or statically - their generative themes may be found. A group which does not concretely express a generative thematics -- a fact which might appear to imply the nonexistence of themes -- is, on the contrary, suggesting a very dramatic theme: the theme of silence. The theme of silence suggests a structure of mutism in face of the overwhelming force of the limit-situations (p. 97).

[22] cf. Freire, Pedagogy of the Oppressed, op. cit., pp. 100-118. Also see Madeleine MacDonald (Ed.), Unit 18 the Curriculum and Cultural Reproduction I (Great Britain: The Open University Press, 1977).

[23] Feire's notion of "limit-situation" is important here. The subject, as a conscious being, aware of self and the world, exists in a "dialectical relationship between the determination of limits" and his/her own freedom.

> As they (i.e. the subjects) separate themselves from the world, which they objectify, as they separate themselves from their own activity, as they locate the seat of their decisions in themselves and in their relations with the world and others (the subjects),

> overcome the situations which limit them: 'the limit situations'. Once perceived by men as fetters, as obstacles to their liberation, these situations stand out in relief from the background, revealing their true nature as concrete historical dimensions of a given reality. (Subjects) respond to the challenge with actions . . . directed at negating and overcoming, rather than passively accepting, the 'given' (*Pedagogy of the Oppressed*, *op. cit.*, p. 89).

The critical understanding here is: How do subjects perceive the situation at a given time? As given? As fetters? etc. The subject must be aware of the limit-situation in order to overcome it.

[24] Freire refers to the themes introduced by the teacher-student as "hinged themes" due to the function they play within the dialogical setting. They can facilitate the connection between two themes in a program unit (and thus fill-in a possible gap between the two themes), or they can point out the relationship between the general program content and the specific "view of the world" held by the subjects. As an example of a hinged theme, Freire states that the "anthropological concept of culture" can be used because it "clarifies the role of men in the world and with the world as transforming rather than adaptive beings" (*cf.* Freire, *Pedagogy of the Oppressed*, *op. cit.*, p. 114. This theme of "culture" could thus be presented at the beginning of a thematic unit because it is concerned with, and introduces a critical topic wherein the subject's view of culture can then be posed as problematic.

[25] See Arnold Wesker, *Words as Definitions of Experience*, *op. cit.*

[26] Freire's description of banking education is carried out by following behaviorist theory. Also his notion of vertical communication
(A = communique = antidialogic model of communication) is evident in
over
B
behaviorist theory. In educational technology the behaviorist theory is carried out in praxis by applying the instructional design model to the organization (and pre-packaging) of curriculum content.

[27] I use the term "educational media" here, and not "educational technology" because of the connotative meaning of the term media which represents diverse sources of information. The term "technology" is linked to the notion of scientific rationality and denotes a method of organization, a "systematic approach" in organizing instruction, which is based on systems theory, which in turn relies on the empirical-positivistic mode of rationality. This mode of rationality has a constitutive interest in technical control. See Koetting, *op. cit.*, Chapter III.

[28] The "operationalized understanding of knowledge" in educational technology is not knowledge, but information. Any concept that is operationalized is essentially reduced to having behavior conform to external criteria for evaluation purposes.

[29] The views/assumptions which I believe need to be reconceptualized are:

> Knowledge *vs* information; the subject-in-context; the use of media for instructional and evaluative purposes; and the purpose of educational praxis.

[30] To delineate the radical differences between the behavioral and emancipatory models, I could ask the question "how would each model treat basic skills" (*i.e.* reading, math, writing, etc.)? The behavioral/systems approach (model) would design programs to teach these skills so that the learners could function within society, could "fit into" or adapt to society. Education for emancipation would teach these skills in order to create an opportunity for the learner to gain access to information that could affect the learner's actions within a social context, that could affect the learner's capacity to "form him/herself", to see his/her reality as a problem and have the critical capacity to change it.

[31] *cf*. John Dewey, *Experience and Education* (N.Y.: The Macmillan Publ. Co., Inc., 1976); Alfred North Whitehead, *The Aims of Education* (New York: The Free Press, 1967).

[32] "Literacy education" is an important issue here. Morrow and Suid's argument in *Media and Kids* (New Jersey: Hayden Book Co., Inc., 1977) is that media can help students with basic communications skills become learners in schools:

> A teaching-learning system that depends primarily on print takes knowledge that is not necessarily beyond a poor reader's intellectual grasp and ruthlessly places it there. Students who fail in reading and writing are not just failing a subject; they are failing their school's chosen mode of communication, and the contents of *all* their various courses are consequently denied to them . . . Time and again, students who bring a long tradition of personal failure with print into the classroom show themselves able to achieve in the other media (p. 17).

Their book does not suggest de-emphasizing the teaching of basic skills, however, in favor of production skills for media projects. Also, *cf*. Elliot W. Eisner, *The Educational Imagination* (N.Y.: Macmillan Publishing Co. Inc., 1979).

[33] In stating that the starting point for curriculum development is *subject content*, which is determined by the teacher-student with students-teachers, I want to also acknowledge the fact that, in many teaching situations, subject-content is determined by curriculum specialists, administrators, school boards, etc., sometimes independent of the teachers who are teaching the particular course. I also want to acknowledge that teachers working with such predetermined content areas are able to create diversity in presenting materials for instruction and in the manner of chosing materials and topics to be considered for instruction by seeking out diverse sources of information that can open and add new dimensions to the topic under investigation.

[34] cf. Morrow and Suid, *Media and Kids* (*op. cit.*), p. 8. These authors refer to their diagrammatic model as the "media wheel". The media wheel is used as both a means of organizing materials for bringing diverse sources of information to bear on learning about a particular topic (presentation wheel), and as a means for evaluating the learning that has taken place (production wheel). The diagram for the media wheel has the "subject" matter (content) as the "hub" of the wheel, and the diverse sources of media as the spokes for the wheel.

[35] Morrow and Suid, in *Media and Kids*, *op. cit.*, delineate three forms of reaction to media presentations: *simple reacting* to the presentation (*i.e.* liking/disliking the production); *informal discussion*, or give and take reactions, wherein views "clash and illuminate one another"; and *formal reaction*, wherein critical analysis of the production is carried on that requiure judgments to be made regarding the "aesthetic" and "truth" dimension of the specific work under discussion (p. 11). It is within the *formal* reacting phase that I would see the emancipatory potential of media within education.

[36] Students-teachers' production efforts become the "codification" of reality in forms (symbols) that the students-teachers can understand. The productions (codifications) are presented to their peers, and the resultant discussion and critical analysis becomes the "decodification" process that Freire describes.

[37] Another way of involving students-teachers in the "planning" and organization of materials for instruction is the "webbing" method described by Herbert Kohl, *On Teaching* (New York: Bantam Books, 1977) pp. 29-49. Kohl presents a logical and legitimate way of sharing the responsibility of curriculum development. The teacher-student with students-teachers are involved in dialogue from the beginning and students-teachers are regarded as capable of contributing to and co-determining content for investigation.

[38] cf. Michael W. Apple, *Ideology and Curriculum*, *op. cit.*, Chapter Seven; James Morrow and Murray Suid, *Media and Kids*, *op. cit.*, Chapter Two; and Elliot W. Eisner, *The Educational Imagination* (New York: Macmillan Publ. Co., Inc., 1979), Chapter Seven.

[39] Earlier in this same book (*The Educational Imagination*, *op. cit.*) Eisner states his case more forcefully:

> I believe that we need evaluation methods that exploit the variety of expressive forms through which we understand and make public what we know. So much of the current evaluation methods emphasizes written language and ability in mathematics; yet, these forms of expression in no way exhaust the ways in which conception and expression occur in the culture at large. We need evaluation methods that give students the opportunity to use, for example, artistic forms of expression as intellectually legitimate and that cease penalizing students whose aptitudes and interests motivate them to work in such areas. Evaluation methods should be instrumental to the ends we seek; they should not, as so many of them do now, impede the realization of such ends (p. 17).

Thus, legitimate views that students-teachers have can be adequately expressed in diverse modes of communication. The presentation-production model for curriculum as discussed previously would prove most helpful here.

[40] Although I am arguing here for the interpretive and critical forms of rationality, I am not negating the empirical form of rationality which also can be used. The empirical, interpretive and critical forms of inquiry are all valid forms of rationality with constitutive interests (*cf*. Koetting, *op*. *cit*.; Habermas, *op*. *cit*.).

[41] C. Wright Mills, in *The Sociological Imagination* (New York: The Grove Press, Inc., 1961) states the issue similarly:

> The specific methods-as distinct from the philosophy-of empiricism are clearly suitable and convenient for work on many problems, and I do not see how anyone could reasonably object to such use of them. We can of course, by suitable abstraction, be exact about anything. Nothing is inherently immune to measurement.
>
> If the problems upon which one is at work are readily amenable to statistical procedures, one should always try to use them. If, for example, in working out a theory of elites, we need to know the social origins of a group of generals, naturally we try to find out the proportions coming from various social strata. If we need to know the extent to which the real income of white-collar people has gone up and down since 1900, we run a time-series of income by occupation, controlled in terms of some price index. No one, however, need accept such procedures, when generalized, as the only procedure available. Certainly no one need accept this model as a total canon. It is not the only empirical manner.
>
> We should choose particular and minute features for intensive and exact study in accordance with our less exact view of the whole, and in order to solve problems having to do with structural wholes. It is a choice made according to the requirements of our problems, not a 'necessity' that follows from an epistemoligical dogma.
>
> I do not suppose that anyone has a right to object to detailed studies of minor problems. The narrowed focus they require might be part of an admirable quest for precision and certainty; it might also be part of a division of intellectual labor, of a specialization to which, again, no one ought to object. But surely we are entitled to ask: If it is claimed that these studies are part of some division of labor which as a whole constitutes the social science endeavor, where are the other divisions of which these studies are parts? And where is the 'division' wherein just such studies as these are put into some larger picture? (pp. 73-4).

[42] *cf*. Ann D. Becker, "Alternative Methodologies for Instructional Media Research", in *AV Communication Review*, Vol. 25, No. 2, Summer 1977, who suggests some limitations of behavioral research designs as used in educational technology and offers some possible alternatives. Also see Francis E. Clark and Jay F. Angert, "Research on Media - Where Do We Go From Here?", unpublished paper presented at the AECT National Convention, Research and Theory

Division, New Orelans, Louisiana, 1979; and Geof Tabakin, Working Paper, University of Wisconsin, Fall, 1979. The authors of these three articles argue for the need of alternative research strategies to the behavioral model.

[43] cf. Patton, Alternative Evaluation Research Paradigm (Grand Forks, N.D.: University of North Dakota), 1975, who expands on this use of standardized tests:

> The problem is not simply one of finding a new or better standardized test. The problem is one of understanding the context of observed behaviors, the meaning of specific achievement outcomes to the child in a more holistic setting than is possible with any standardized test. This does not mean that standardized tests may not be useful for certain specific questions, but they are not sufficient when the issue is understanding, not just prediction. Understanding in its broadest sense requires getting close enough to the situation to gain insight into mental states; it means subjectivity in the best scientific sense of the term. The alternative paradigm seeks to legitimize and incorporate this subjectivity into evaluation research, not to the exclusion of the methodology of the dominant paradigm, but in addition to it (p. 25).

Also cf. Elliot W. Eisner, The Educational Imagination (op. cit.) Chapter One.

[44] cf. Alan Tom, "Critique of Performance Based Teacher Evaluation", in The Educational Forum, Nov., 1977. Although competency based education is applicable and valid in training and mastery of certain skills, when applied to other areas of learning (outside of training and skills), it over simplifies a complex activity (e.g. teaching) and therefore, as a rationale for evaluating learning situations, it is an inadequate means of investigating all learning situations. cf. James B. MacDonald, "The Quality of Everyday Life in School" in James B. MacDonald and Esther Zaret, eds. Schools in Search of Meaning (Washington, D.C.: Association for Supervision and Curriculum Development, 1975b). MacDonald states that the notion of teacher competency (which implies that "teachers are potentially interchangeable") results in viewing productive activity as something "learned" and "performed mechanistically". Thus, any "good" teaching activity is reproducible by any other teacher, and "all productive teaching is measurable in terms of the criteria of accountability in use" (pp. 79-80). Also see Manfred Stanley, The Technological Conscience, (The Free Press: New York) 1978, pp. 200-201, and Eisner, The Educational Imagination (op. cit.), Chapter One.

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The Effect of Vicarious Partial Reinforcement Upon Children's Use of Self-verbalization in Decisions Regarding Television Viewing

Sandra S. Korzenny
Secondary Education and Curriculum
Michigan State University
E. Lansing, Michigan 48824

Paper presented at the Association for Educational Communications and Technology's Annual Convention, Philadelphia, PA April, 1981

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I. Background and Theoretical Framework

A. The Impact of Television: The question of the effects of viewing television upon children has been the subject of numerous research efforts over the past several years. Specifically, researchers have attempted to evaluate the role that televised violence may play in shaping young children's behavior. Although the results of these investigations have not settled this controversy, there is concern that children who are heavy viewers of television may be learning and imitating behaviors which are potentially harmful to themselves and others.

Setting aside for a moment the particular question of the effects of televised violence upon children, there is concern that children are spending a significant number of their non-school hours in front of the television, be it violent or not. One reason for this concern is the pervasiveness of television in our society. In a study by Nielsen (1976), it was found that only three percent of all households own no television; 43% own two or more sets; and 70% of American families own color sets.

Young children are avid viewers. Schramm, Lyle, and Parker (1961) found that over one-third of the children interviewed made "regular use" of television by age three and over 90% were regular viewers by age six. Lyle and Hoffman (1972) reported that first graders watch slightly less than 24 hours per week; sixth graders, about 30 hours, and 10th graders, 28 hours. Nielsen (1976) reported that children from the ages of two through 11 watch an average of 26 hours per week.

The programs that children view cover the entire range of available hours - from weekday mornings to evening prime time to Saturday and Sunday mornings. Nielsen reported the following data: a. 16% of the total viewing time for children two through 11 is on Saturday and Sunday mornings; b. for children two through five, 30% occurs on weekday mornings and afternoons before 4:30; then, 4:30 to 7:30 makes up 27% of their viewing time, while 7:30 - 11:00 accounts for 24% ; c. for the older children (over five), prime time accounts for 36% and late afternoon and early evening account for 30%.

What impact does all of this viewing have upon children's behavior? There is some basis for the belief that exposure to televised violence may result in increased aggression in at least some children under certain conditions. In a review of the literature in this area, Atkin, Murray and Nayman (1971) report the following:

> More than 20 published experiments show that children are capable of imitating filmed violence, although a variety of situational and personal factors combine with exposure to determine actual imitation. Another 30 published exeriments indicate that violence viewing increases the likelihood of subsequent aggressive behavior, at least in the laboratory context. (p. 23)

Does this vast amount of televiewing have other effects upon development? Television has been blamed for a number of societal illnesses: poor grades, lack of writing skills, illiteracy among young adults, and a general lethargy with regard to planning and working towards one's goals for the future. While television's specific contribution to these problems is unknown, the amount of time children spend in front of the television does substantially reduce the opportunity for acquiring skills through participation in other activities.

In response to this concern, the following questions have emerged: 1.) Can the amount of violence on television be reduced?; 2.) How does one help children to be less inclined to imitate the violence they view and to evaluate the reality of television more critically?; 3.) Can children learn to make decisions about what to view and whether to view based upon evaluation of the consequences of their behavior? These questions are dealt with in the following section.

B. Strategies to Mediate the Effects of Television: Consumer advocate groups, such as Action for Children's Television and the National Association for Better Broadcasting have attempted to respond to the first question by petitioning the networks to decrease the number of violent incidents seen on television. Tactics such as this have had questionable success.

Utilizing a different approach, several educational communication researchers have devoted effort to investigating possible methods of assisting children in altering their perceptions of reality of television and examining their reasons for viewing. These investigations have been expoloring the role that the schools might play in mediating the effects of television. Curriculum intervention strategies have been developed and evaluated to measure the effect they might have upon mediating learning from television. (Doolittle, 1977; Roberts, 1978; Anderson and Ploghoft, 1977; National PTA; Singer and Singer, 1978; CASTLE, 1978. For a description of these strategies, see Korzenny, unpublished dissertation, 1980, pp. 22-26.)

In contrast to these intervention strategies which attempt to teach children to evaluate more critically what they view on television, the present study attempted to address the last question stated above: Can children be guided to examine their reasons for viewing, resulting in a reduction of the number of hours spent in viewing? Essentially, can children be taught to increase control over their lives and to participate in more goal-related activities?

C. Gaining Self-control through Self-verbalization: Through various means, adults and children attempt to gain some measure of self control. In gaining greater self-control over our lives, we frequently must learn to be more reflective about our behaviors and their consequences. We must often ask ourselves, "If I engage in a certain behavior, what will be the short and long-term consequences: Are there alternative behaviors which may be more socially acceptable or contribute toward a 'healthier' life, even though they may not be immediately satisfying?" Individuals seeking greater self-control replace maladaptive behaviors with such socially acceptable behaviors. Illustrations may be seen in people who learn to eat less in order to lose weight or learn to stop smoking. Self-control may also be seen in young children who learn to solve conflicts verbally rather than physically. Quite often, the maladaptive behaviors, such as eating and smoking or physically hurting another person, are immediately gratifying, but, in the long run, harmful in one way or another. If an individual can see that an immediately gratifying behavior may have ultimately harmful consequences, then s/he may behave in a different manner. Learning to be more reflective about one's actions by analyzing long and short term consequences of various alternative behaviors may be a step towards gaining greater self-control.

Research suggests that self-verbalization may be one effective method of analyzing behavior and its consequences. (Meichenbaum, 1977) Self-verbalization involves thinking aloud or talking to oneself leading to a conscious decision to behave in a certain manner. It is suggested by the results of various research efforts that habitual, maladaptive behaviors such as passive television viewing may be brought under one's control if they are preceded by deliberate cognitions. (Meichenbaum and Goodman, 1971; Spivack and Shure, 1974; Camp, Blom, Herbert, and Van Doorwick, 1976). Self-verbalization consists of "talking to oneself in relevant ways when confronted with something to be learned, a problem to be solved, or a concept to be attained." (Jensen, 1966.) In such a way, humans may learn to make decisions based upon a logical examination of alternative actions and consequences of those actions. As an illustration, from the context of the present study, a child must decide whether to view television or do homework. S/he decides not to view television but to do homework, based upon a deliberate consideration of both alternatives and their consequences. She has questioned herself, in both cases, about the consequences of performing either alternative and has decided in favor of that alternative which provided long-term consequences which were more positive than those of viewing television.

D. Teaching Self-verbalization through Modeling: How does one go about the task of teaching self-verbalization? The question of an effective method of teaching self-verbalization has been the subject of various research efforts. The ability to produce covert, self-guiding speech appears to be the result of a developmental progression during which one's behavior is first controlled by an adult's speech and actions, later by one's own overt speech, and, still later, by one's own covert speech. This progression suggests that modeling may be an appropriate method of teaching self-verbalization.

Researchers have investigated the use of modeling to teach self-verbalization and found it to be effective in teaching people to produce positive self-statements which are incompatible with negative ones, to covertly deal with maladaptive thoughts and to replace negative behaviors with actions that are conducive to effective participation within society. (Meichenbaum and Goodman, 1971; Sarason, 1973; Glass, 1974; Schmurak, 1974; Mahoney and Thoresen, 1974).

Bandura (1977) states that one component of observational learning (modeling) which contributes towards observer adoption of that behavior is the reinforcement of the model upon performance. Those behaviors that seem to result in valued outcomes are more likely to be adopted. This is referred to in the literature as vicarious reinforcement, or "the operation of exposing O (the observer) to a procedure of presenting a reinforcing stimulus (i.e., a presumed or confirmed reinforcing stimulus for O) to M (the model) after and contingent upon a certain response by M" (Flanders, 1968). As a function of their viewing of these vicarious rewards, the observers will attempt the behavior in order to accrue those rewards. In laboratory settings, where it is easier to control outcomes, the observer may be assured of a greater percentage of reinforcing stimuli. In the classroom, as in the laboratory, the environment may be controlled so that the child is successful in eliciting positive consequences for imitating a certain behavior; however, when the child leaves that controlled classroom environment and attempts the behavior in his/her own home, the consequences can be either positive or negative. What will occur, in an uncontrolled situation, in which the observer imitates a behavior and is frustrated by unsuccessful attempts in achieving those same reinforcing results as those elicited by the model? It may not be possible to assure the observer of a high percentage of reinforcement for imitating a modeled behavior, but it may be both desirable and feasible to shape the expectations of the observer with regard to a realistic rate of reinforcement which might be obtained upon imitation of the modeled behavior.

E. The Vicarious Partial Reinforcement Effect: Based upon Festinger's social comparison theory (1954) one would predict that when observers are attempting an unfamiliar task, which they have seen modeled, they will compare their own performance with that of the model - as long as the model is perceived to have generally similar ability or beliefs. They may be uncertain as to the standards of performance and use the model's standards as an example. Thus, if they have "failed" in their attempts at imitation and have seen a model consistently rewarded, they may become frustrated and decline to persevere in performing that behavior. This phenomenon has been termed the expectancy-frustration hypothesis (in Berger,1971). According to this hypothesis, because unsuccessful observers perceived a greater discrepancy between their performance and that of a successful model, they may become frustrated and quit sooner than observers who may have viewed a partially unsuccessful model performing the same task. With a behavior such as deciding whether or not to view television, one would predict that the consequences for not viewing will not always be positive. If a child decides not to view television, but to do her homework, she may be criticized by her friends for that decision. This criticism may cause her not to select an alternative activity to television in the future, as she may cognitively expect to always be criticized for that decision.

It may be appropriate, then, to expose the observers (learning to self-verbalize about selection of free time activities) to a model whose decision to not view TV results in positive outcomes in only a certain percentage of cases. This is known as vicarious partial reinforcement.

Researchers investigating this hypothesis have sought to study the effects of manipulating the percentage of vicarious reinforcement upon imitation and extinction of imitation of modeled behavior. Traditionally, these studies have compared two or more groups which view models being reinforced at varying percentages of reinforcement. One group will view a model reinforced 75% of the time, while the other group will view a model reinforced only 25% of the time. As stated above, the effect upon either imitation or extinction is the dependent variable.

Six investigations into the effect of vicarious reinforcement upon imitation reported increased imitation as a function of increased percentage of reward. (Chalmers, et.al., 1963; Bisese, 1966; Marston and Kanfer, 1963; Mausner and Block, 1957; Rosenbaum, et. al., 1962; Rosenbaum and Tucker, 1962).

Conflicting results have been obtained from studies which have investigated the effect of varying the percentage of vicarious reinforcement upon extinction. (Extinction has also been defined as perseverance in performing a task in the absence of reinforcement.) Lewis and Duncan (1958) and Thelen and Soltz (1969) and Paulus and Seta (1975) found no difference in extinction as a function of percentage of vicarious reward. Others (Bisese, 1966; Rosenbaum and Bruning, 1966) found that high percentage vicarious reward observers showed greater resistance to extinction than low percentage vicarious observers. Still other studies have found increased resistance to extinction as a function of decreased percentage of vicarious reward. The subjects in the relatively unsuccessful model condition generally completed more trials than those in the relatively successful model condition.

Support for this hypothesis may be found in the area of persuasion: research on the effects of one-sided vs. two-sided messages. Hovland, Lumsdaine and Sheffield (1949), and Lumsdaine and Janis (in Hovland, Janis and Kelley, 1953) examined the effectiveness of presenting the two sides of a question as opposed to one. Both sets of researchers found that the person who has been exposed to both the positive and negative sides of an argument, has, in effect been "inoculated" against the negative arguments when they subsequenctly appear. S/he is less likely to be influenced by those arguments than someone who has only been exposed to the positive side of that argument. If a person has only heard one side, his/her opinions tend to be swayed back by the valid, negative arguments when they subsequently appear.

What are the implications of the results, regarding sidedness of arguments applied to the vicarious partial reinforcement effect? If the modeled behavior involves attitude change as in the present study, this research seems particularly applicable. When an observer has viewed a model who is partially reinforced for displaying a behavior consistent with a certain attitude, as opposed to a model who is consistently reinforced, s/he may not be as inclined to discredit the "message" when and if s/he subsequently fails in attempts at successful imitation. In effect, s/he has been "inoculated" against failure and may be more willing to persevere even though s/he has experienced negative consequences. S/he is already familiar with the negative point of view (failure) and has previously been led to a positive conclusion in a context of presentation in which failure was present.

F. Summary and Research Questions: In summary, three bodies of literature reviewed here provide the background for the present study. Related curriculum intervention strategies were discussed to provide an understanding of what has been done in the field. A number of studies have demonstrated that self-verbalization can be an effective method for learning new patterns of behavior in attaining greater self-control over one's life. Further, observational learning can be an effective means of learning self-verbalization. On the question of vicarious reinforcement, it may be more probable that perseverance at a task can be maintained by presenting an observer with a model who elicits both positive and negative outcomes through his/her behavior, although the results regarding these questions are divergent.

The basic research question which this study attempted to address was whether children could be taught to consider carefully their behavior and its consequences, thereby participating to a greater degreee in non-TV activities which contribute to the achievement of goals.

Specifically, the research questions were:

1. Will varying the percentage of vicarious reinforcement have an effect upon actual use of self-verbalization in making decisions about use of leisure time?
2. Will varying the percentage of vicarious reinforcement have an effect upon stated preference for participation in activities other than television viewing?
3. Will varying the percentage of vicarious reinforcement have an effect upon the number of hours spent in certain activities?
4. Will varying the percentage of vicarious reinforcement have an effect upon advocacy of selection of activities?
5. Will varying the percentage of vicarious reinforcement have an effect upon recall of self-verbalization used by the model?

II. Methods

A. Sample and Selection Procedure: The sample consisted of 66 third grade pupils from three classrooms within three schools in a small community near E. Lansing, MI. Figure 1 represents the schools, classrooms, and number of students used in the study.

Insert Figure 1 here

The principal selected the classrooms for the study. A planning meeting was then held among teachers, principal, and the researcher to arrange the schedule.

At the time of data analysis, 10 subjects had been dropped from the sample because of absenteeism. The resulting sample size analyzed was 56, as follows:

Class 1= 20   Class 2= 18   Class 3= 18

B. Design: The present study was essentially a quasi-experimental design with two treatment groups and one control group, as shown below:

Class 3	O_1	X	O_2	O_3
Class 2	O_1	X	O_2	O_3
Class 1	O_1		O_2	O_3

Intact classrooms were assigned to treatments. The X's represent exposure to the experimental variable (percentage of vicarious reinforcement). O_1 is the pretest, O_2 is the immediate posttest (three days following the end of the instructional unit), and O_3 represents the delayed posttest (three weeks following the end of the instructional unit.)

The variable matrices take the form of a two-way repeated measures design, having two factors:

a. the design over measures factor: the point in time of testing (pre-, post-, and delayed posttest).

b. the design over subjects factor: the percentage of vicarious positive reinforcement (100%, 50%, and the control group, which received no treatment.)

Two variable matrices (see Figures 2 and 3) were constructed to display the varying points in time of measurement depending upon the dependent variable being measured. Four dependent variables were measured at all three points in time (recall was only measured at Posttest 1 and Posttest 2.) Figure 2 represents the variable matrix for those five variables.

Insert Figure 2 here

Two other dependent variables, those related to actual time spent in activities, were measured twice, at points O_1 and O_3. Figure 3 represents the variable matrix for those two variables.

Insert Figure 3 here

The design was considered quasi-experimental because the subjects were not randomly assigned to the experimental and control groups.

C. Treatment: The instructional unit consisted of five 45-50 minute lessons. The lessons were used on five consecutive school days. The following is a brief outline of the lesson content.

The unit included two basic components: a slide tape presentation and guided discussion, supported by student workbooks.

The model selected to appear in the slide-tape presentation was a female, 12 year old. Research in the area of modeling suggests that perceived similarity between the model and observers with relation to likes and dislikes is of importance in determining whether the model's actions will be imitated (Festinger, 1954). For this reason, it was emphasized to the subjects that the model was interested in the same types of activities as they were. (These activities were determined by questionnaire.)

The slide-tape presentation shown to students depicted the model engaged in decision-making (using self-verbalization) regarding her own use of free time. In one treatment design, the model experienced negative consequences upon selection of an activity other that viewing television, in two situations. In two situations, the model experienced positive consequences. Thus, the subjects in one treatment group viewed the model receive 50% negative/ 50% positive consequences (to test the vicarious partial reinforcement effect) while the other group viewed the model receive 100% positive consequences.

Briefly, the situations and consequences are described below:

Situation 1: Model decides to ride bicycles with her brother instead of watching TV.

Treatment 1: (Group 2)	She and her brother enjoy the ride and she expresses the feeling that she had fun.
Treatment 2: (Group 3)	She falls from her bike and expresses the feeling that wishes she had not gone.

Situation 2: Model decides to bake cookies instead of watching TV.

Treatments 1 and 2: Model is rewarded by family for baking cookies.

Situation 3: Model decides to play a game with her brother and friend instead of watching TV.

Treatment 1: She enjoys playing the game with her brother and friend and expresses that feeling.

Treatment 2: She does not enjoy the game and expresses her feeling.

Situation 4: Model decides to play with her puppies instead of watching TV.

Treatments 1 and 2: She enjoys herself and expresses her feeling.

In all situations, the model selected the activity alternative to television viewing with the specific intent of achieving a certain goal. For example, in Situation 1, she selected bicycle riding with the intent of having the opportunity to talk with her brother. In Situation 2, baking cookies was selected over television viewing because the model expressed a goal of "doing something nice" for her brother and friend.

The first day of the instructional unit involved setting rules for discussion to be followed throughout the week. Topics discussed were goals, use of free time, and how to make decisions about use of free time. No slide-tape exercise was done this day.

Lesson 2 involved a review of the first lesson. The first slide-tape was also presented. Workbooks were used during the discussion of the slide-tape situation. In addition, a game was played which allowed students to practice selecting activities to achieve goals.

Lesson 3 consisted of a review of the previous lesson, a second slide-tape, and a discussion of pro-and anti-social television programming.

Lesson 4 followed the same format with a review of the previous lesson, the third slide-tape exercise, and a discussion of goals and activities. The last exercise dealt with deciding how to spend their own time in order to achieve their own goals. All exercises allowed for practice in self-verbalizing.

The last day began with a review; this was followed by a discussion of the growing concern about children viewing too much TV, and the last slide-tape. The emphasis of the last exercise was on the theme of being active participants in society rather than passive viewers of television. A summary of what students had learned was then elicited from them.

D. Validation of the Instructional Unit: Several steps occurred in the validation of the instructional unit.

1. A pilot group of subjects was obtained. This consisted of two third grade classrooms from a community of similar characteristics as those of the group under study.

Prior to the experiment, the researcher requested from the pilot group subjects a list of activities in which they participated when not viewing television. From these activities, four were chosen which provided the basis for the slide-tape presentation of situations.

2. Using the pilot group, the researcher determined whether the planned consequences to the model were perceived by the subjects as being positive or negative.

3. Goals, objectives, and measures were formulated.

4. Lessons were designed.

5. Lessons and measures were pretested on the pilot group.

6. Lessons and measures were revised where appropriate.

E. Assignment of Classes to Conditions: There were three conditions in this study: two treatment and one control group. The two instructional units were identical except for the consequences experienced by the model in two out of the four situations. In T_1, the model received positive consequences for her decision in all four situations. In T_2, the model experienced positive consequences in two situations and negative consequences in two situations.

The classes were randomly assigned to the following conditions:

Class 1 - Control
Class 2 - 100% Positive consequences (T_1)
Class 3 - 50% Positive consequences (T_2)
50% Negative consequences

F. Administration of the Treatment: The researcher began the treatment by introducing herself to the class and explaining that for the next five days the students would be participating in activities which focused on how they made decisions regarding their use of free time. Each day there were activities, discussion, and summaries at the end of the day to describe main points during that day's lesson. Workbooks were given to the students which accompanied classroom discussion regarding long and short term goals, decisions about use of free time, and types of programming. Each day students used the workbooks, viewed a slide-tape, and discussed what was viewed.

The regular classroom teachers remained at their desks in the back of the room during the treatment. They did not participate during the experiment. In addition, they were instructed not to refer to the instructional unit at any other time. An observer was present during all activities to establish that objectives had been covered in order to determine if the unit was implemented as intended.

Prior to the formal investigaiton, the treatment and instruments were tested in the two pilot third grade classes. Revisions were made as a result.

III. Instrumentation

A. Dependent variables: The dependent variables in this study represent the objectives of the instructional unit. Five broad areas of change were intended by the instructional unit:

1. Use of self-verbalization
2. Preference for participation in activities other than viewing of television.
3. Advocacy of choice of non-television activities even though this may not always result in positive outcomes. Reasons for advocacy were also measured.
4. Reduction in the number of hours spent in viewing television
5. Recall of self-verbalization used by the model.

B. Administration of the Instrument: The instrument was read aloud to the students in the classrooms. At the outset, the students were told that there were no right or wrong answers; that they should only respond carefully with their own opinions and feelings. Students were asked not to speak to each other or look at each other's answers during the testing procedure. All items were read to the class as a whole with sufficient pause for responses.

The measure of hours of viewing was given each morning. Students were asked to fill in the programs they had viewed the previous day and night. These were collected each day. This information was collected only at times of the pretest and posttest 2.

C. Validity: Content validity was examined for all measures. Mehrens and Lehman (1975) state that:

> Content validity is related to how adequately the content of, and responses to, the test samples the domain about which inferences are to be made.

There is no numerical expression for content validity; subjective comparisons were made through inspection of the items to judge whether the items represented the content of the instructional unit. A "detailed, systematic, critical" inspection of the test items has been described as the single best way to determine content validity (Mehrens and Lehman, 1975). This was achieved in the present study by having one other person familiar with the study serve as judge of the content validity of the test. All objectives, activities, and lesson plans were discussed by the judge and the researcher. Then the test was reviewed and the determination was made that the items represented the content that the test was designed to measure.

D. Reliability: Estimates of internal consistency and measures of scorer reliability were computed for the variables in this study. The estimates of internal consistency for the present study are reported as Cronbach's coefficient alpha. Table 1 presents alpha coefficients for those variables for which this estimate was computed, at the time of the pretest.

Insert Table 1 here

Measures of scorer reliability were computed for the variables which required the assignment of subjects' free responses to categories predetermined by the researcher.

Measures of scorer reliability were determined for these variables in the following manner. The researcher reviewed and listed all possible responses for the variables. Two judges were hired to assign subject responses to the categories. (The researcher independently assigned responses to categories.) Categories were reviewed with the judges, and they were allowed to practice assignment. Judges were then asked to independently read through questionnaires and assign responses to the categories. At ten random points throughout the sessions, judges were asked to read a subject's response and report and discuss their assignment of a response to that category. The percentage of agreement was then calculated and reported (see Table 2).

Insert Table 2 here.

IV. Hypotheses

Hypotheses and analysis procedures are presented below.

H_1: There will be a difference among groups in the percentage of students using self-verbalization at each posttest:
  a) At posttest 1, a greater proportion of Group 2 subjects will use self-verbalization than Group 3, which will be greater than Group 1;
  b) At posttest 2, a greater proportion of Group 3 subjects will use

self-verbalization than Group 2, which will be greater than Group 1.

This hypothesis called for a test of the use of self-verbalization in making decisions about television use. It was predicted that as observers were given an opportunity to "test out" the effect of self-verbalization at home, they would compare their results with those experienced by the model.

At posttest 1, it was predicted that there would be a greater proportion of subjects using self-verbalization in Group 2 (100% vicarious positive consequences) than in Group 3 (50%/50%). This was based upon reinforcement theory: the response (in this case, the use of self-verbalization) would be strengthened by reinforcement. Observation of another person's reinforcing outcomes might affect the degree of imitation of the modeled behavior; the more frequent or strong the reinforcer, the greater the probability the behavior would be imitated. (Bandura, 1971)

As time passed, however, if observers failed to obtain positive results in their own attempts at the behavior, they might become frustrated and not attempt to use self-verbalization again. Those who had observed a model always obtain positive results (those in the 100% vicarious reinforcement group) might become frustrated and not persevere in their own attempts. For this reason, it was expected the percentage of subjects using self-verbalization in Group 2 would drop at posttest 2.

Dependent variable: Use of self-verbalization

Measure:

Do you ask yourself questions before deciding whether to watch television?

Yes ________ No ________

Statistical Procedure: Chi-square test of homogeneity of patterns of response to categories across groups.

H_2: There will be an interaction offect with regard to preference for viewing television versus participation in an alternative activity:

a) At posttest 1, Group 2 will show greater preference for the alternative activity than Group 3, which, in turn, will show greater preference for the alternative activity than Group 1.

b) At posttest 2, Group 3 will show greater preference for the alternative activity than Group 2, which, in turn, will show greater preference than Group 1.

This hypothesis called for a test of the position of the observers towards "viewing television" as compared to alternative activities. It was predicted that Group 2 subjects, those who had seen a model reinforced 100% of the time, would show a stronger preference for alternative activities at the time of posttest 1.

It was predicted that this effect would diminish as time intervened and the subjects had an opportunity to test out "preference for activities." Group 2 subjects would be more likely to decrease their expression of that preference by the time of the posttest 2 measure. It was predicted that Group 3 subjects would be more likely to persist in expressing preference for alternative activities, having seen a model alternately succeed and fail in obtaining positive results for expressing that preference. Thus, they would not expect continuous positive reinforcement for their own efforts.

Dependent variable: Preference for leisure time activities

Measure: 14 dichotomous variables of the following form:

> If you had an hour or two of free time, what do you think would be the best way for you to spend it? Circle your answer.
>
> Watch an adventure show or Read an adventure

Statistical Procedure: Repeated measures analysis of variance.

H_3: Group 3 will display greater advocacy of selection of an alternative activity than Group 2, which, in turn, will display greater advocacy than Group 1, at posttest 1 and posttest 2.

This hypothesis called for a test of the expectancy frustration hypothesis. It was predicted, based upon this hypothesis, that subjects in the 50% positive reinforcement condition would be more likely to advocate the selection of an alternative activity even if it had previously not resulted in positive outcomes. This was because they had viewed a model experience both positive and negative outcomes and would not expect consistent, positive outcomes. They would be more likely to advocate persistence in the behavior than subjects who had viewed a model experience continuous (100%) positive outcomes.

Dependent variable: Advocacy of selection of an alternative activity.

Measure: Four items of the following form:

> Yesterday, Bob came home from school and he thought carefully to himself: "I've got some free time. I could go play kickball or I could watch TV. If I play kickball, I could get some exercise. If I watch TV, I could just relax. If I want to get in shape, I should play kickball."
>
> Bob went out to play kickball. He accidentally tossed the ball into someone's window. He knew that he would have to pay for a new window. Bob felt that if he had just stayed in and watched TV, none of this would have happened. He wonders what he should do the next time?
>
> If you were Bob, what would you do next time?
>
> Watch TV__________ Play kickball _________
>
> Why would you do that? _______________________
>
> ____
>
> ____

Statistical procedure: Repeated measures analysis of variance.

The item "Why would you do that?" was measured in the following manner. The researcher coded each of the responses into one of four categories:

1.) I would play kickball because you might not hit the window again;

2.) I would play kickball because it's important for my goals.

3.) I don't know.

4.) I would watch TV so I wouldn't break the window again.

For each of the vignettes such as the one above, there were appropriate categories for that item. Frequencies of response to those categories were measured and significance was tested.

H_4: Group 3 will experience a greater reduction in total number of viewing hours, and an increase in total number of hours spent in alternative activities, than Group 2, which will experience a greater reduction in viewing and an increase in alternative activities than Group 1.

Again, the expectancy-frustration hypothesis would support this prediction. If the observers were given an opportunity to "test out" the decision-making strategies at home, they would compare their results to those accrued by the model. If they failed to obtain positive results and had never seen the model "fail," they might become frustrated and not attempt any more trials. Those who had observed a model "fail" may not become as frustrated and may persevere in their attempts.

Dependent variable: Number of hours of television viewing
Number of hours in alternative activities

Measure: See Appendix C (Hours data were collected for five days: Saturday, Monday, Tuesday, Wednesday, and Thursday)

Statistical procedure: Repeated measures analysis of variance.

H_5: There will be a difference among groups in the proportion of subject recall of self-verbalization used by the model at posttest 1 and at posttest 2.

This hypothesis called for a test of recall of the self-verbalization used in the instructional unit. It was expected that Group 2 would be more likely to recall self-verbalization used by the model than Group 3. This was based upon reinforcement theory: the response (in this case, the actual content of self-verbalization) was strengthened by reinforcement. Observation of the model's reinforcing outcomes for self-verbalizing might strengthen the likelihood of the observer's recall of the behavior. The more frequent the reinforcement (100% vicarious prositive reinforcement versus 50% vicarious positive reinforcement) the greater the likelihood of learning the content of the self-verbalization used the model.

Dependent variable: Recall of self-verbalization.

Measure:

> What kinds of things did Jill say to herself before deciding whether or not to watch TV? ______(free response)______
>
> ____

Statistical Procedure: Chi-square test of homogeneity of patterns of response to categories accross groups.

V. Results

The significance level for all tests was set at .01.

1. Use of self-verbalization: It was expected that the treatments would have a differential effect upon the subjects at each posttest period. In analyzing the data for this hypothesis, the dependent variable, use of self-verbalization, was cross-tabulated with treatment group, yielding Tables 3 - 5 . These tables display the reported frequency of use of self-verbalization and

the proportion (or percentage) of subjects per group who used self-verbalization. The figure representing the proportion provides the data for the tests of statistical significance.

Insert Tables 3 - 5 here

A χ^2 test of statistical significance of the homogeneity of the patterns of response to the categories was then performed. This test examined the proportion of subjects per group responding to the categories and tested to see if the patterns of responses differ statistically. If the pattern of response for any one group differed in a statistical sense, the χ^2coefficient would be at a level which is statistically significant.

As can be seen from Tables 3 - 5 , none of the tests was statistically significant. The test which most closely approached significance was that done for the pretest. As can be seen from Table 1, Group 1 more frequently expressed non-use of self-verbalization, as opposed to Group 3, which more frequently expressed use of self-verbalization. Group 2 was evenly divided. It is unknown why the groups were so disparate at this stage.

By examining the figures across time, it appeared that the treatments had little effect upon the use of self-verbalization by the subjects. Group 3 remained relatively stable across all three testing points; Group 2 increased at posttest 2, then decreased; Group 1 also increased and remained the same at posttest 2.

It was concluded from these results that the patterns of response for each group at each posttest did not differ statistically.

2. Preference for leisure time activities:

Table 6 presents the mean scores for all groups at all three measurement points for preference for leisure time activities. Table 7 presents the results of the analysis of variance conducted to test Hypothesis 4.

Insert Tables 6 - 7 here

In Table 7, the analysis of variance table reflects the influence of the treatments upon preference for leisure time activities. The main effects for groups (treatments) and repeated measures were non-significant at the level specified. The interaction effect was significant which warranted further examination of the data.

As can be seen in Table 6 , the greatest increase in preference for alternative activities from pretest to posttest 1 was displayed by Group 2. This was as predicted by the hypothesis. At posttest 2, Groups 2 and 3 showed equal increases. Group 1, the control group, showed a decrease in preference for alternative activities.

It was predicted by the hypothesis that the Group 2 mean would decrease at posttest 2, while the Group 3 mean would continue to increase. As can be seen by Figure 4, this was not the case. The increase for Groups 2 and 3 was equal from posttest 1 to posttest 2.

Insert Figure 4 here

Although the interaction effect was significant, the interaction did not occur as hypothesized. As can be seen from the graph, at posttest 1, Group 2 displayed a greater preference for alternative leisure time activities. Both groups continued to increase preference for alternative activities. It was predicted that Group 2 mean would decrease, while Group 3 would remain constant or increase. The conclusion which may be drawn is that the 100% vicarious reinforcement condition created a greater initial display of preference for activities alternative to television. This preference did not increase at the same rate and by posttest 2 the increase was equal to Group 3's posttest 1- posttest 2 increase. Although a significant interaction effect was found the data did not provide support for this hypothesis.

3. Advocacy of choice of non-television activities:

Table 8 presents the means for all groups at all three points in time. Table 9 represents the analysis of variance for this dependent variable.

As can be seen from the ANOVA table, none of the tests was significant. The data do not support this hypothesis, although trends are in the predicted direction at posttest 1. These trends reversed at posttest 2.

Insert Tables 8 - 9 here

In response to the item, "Why would you or would you not advocate participation in the alternative activity?" the results varied dependent upon the item. Examination of the data revealed that at Posttest 1, the 50%/50% group most frequently advocated continued participation in the alternative activity, even though it had previously resulted badly. This was as expected. The 100% group more frequently advocated television viewing, as in this way, the child in the vignette would avoid negative consequences. Posttest 2 data, however, were difficult to interpret. It appeared to the researcher from all data regarding this measure that any future research using this type of item would require revision.

4. Hours spent in activities:

As can be seen in Tables 11 and 13, the main effect of repeated measures was significant in both tests. This indicates that, regardless of group, there was a significant decrease in the number of hours spent viewing and a significant increase in the number of hours spent in alternative activities. Because the control group also diplayed shifts in the desired direction, alternative explanations for this significant main effect were explored. This is discussed in the conclusions section.

5. Recall of self-verbalization used by the model:

As can be seen from Table 14, the χ^2 coefficient is not statistically significant. In addition, at posttest 1, both frequencies and percentages of response were equal for both groups. At posttest 2, Group 2 decreased slightly in the frequency of accurate response to this item. However, there was no statistical difference between the two groups' ability to recall self-verbalization used by the model. Posttest frequencies and percentages remained fairly stable at posttest 2, as seen in Table 15. The data did not support this hypothesis.

VI. Conclusions

A. Major Findings

1. Actual use of self-verbalization did not increase significantly across time for either treatment or control groups.

2. There was a significant group by measures interaction effect with regard to stated preference for non-television viewing activities. One-hundred percent (100%) vicarious positive reinforcement created a greater initial increase in stated preference for non-television viewing activities. Fifty percent (50%) vicarious positive reinforcement increased only slightly

a preference for non-television activities at both posttest periods.

3. The number of hours spent viewing decreased for all groups (including the control group). There was no significant difference as a result of varying the percentage of vicarious positive reinforcement.

4. There was no significant difference among the groups as a result of varying the percentage of vicarious positive reinforcement in advocacy of selection of alternative actitivities. Results did occur in the predicted direction, however.

B. Major Conclusions

Conclusions drawn from this study must be considered with the following limitations in mind:

a.) Data were collected on the basis of self-report. Subjects were asked to report their attitudes towards variables of interest. The danger of self-report in research is the increased probability of error based on the subjects' willingness to state attitudes which they feel conform to those desired by the researcher. There is particular danger in a study such as the present one, in which the focus is upon attitudes which may or may not be socially acceptable. For this reason, the researcher attempted to corroborate attitudinal data with behavior data.

b.) The accuracy of the behavioral data is based upon the subjects' ability to recall programs viewed. In order to decrease the amount of error in remembering, subjects were required to report programming viewed the following day during the first hour of classes.

A possible explanation for the treatments' failure to impact upon use of self-verbalization may have been because the subjects did not perceived the reinforcement to be directly related to the use of self-verbalization. The subjects viewed the model self-verbalize, select an alternative activity, and be reinforced for that selection. They may have perceived the reinforcement to be for the actual selection of the alternative activity, not for the process of thinking carefully about that selection. One suggestion in redesigning the instructional unit would be to emphasize the relationship between reinforcement and the process of self-verbalization.

With relation to preference for non-television viewing activities, it may be concluded that 100% positive consequences may be more effective in eliciting both immediate and enduring preference for the alternative activity. The 50% positive consequences/50% negative consequences group mean regarding preference for alternative activities was substantially above average before the treatment even began. This would indicate that the subjects were already above average in preference for alternative activites. The control group remained stable at posttest 1 and even slightly decreased preference at posttest 2. It must be recalled, however, that these data were not corroborated with behavioral increases in participation in alternative activities. Given the inconsistency between stated preference and the behavioral data, the conclusions regarding preference for alternative activities are tentative and require further study.

Although the treatment groups did decrease the number of hours spent in viewing television, the control group also evidenced a decrease. One possible explanation for this is that with the advent of spring weather at about the time of posttest 2, all subjects began to spend more time outside in alternative activities. It is suggested that those planning future research on this topic consider seasonal changes and their effect upon the dependent variables.

Generally, the expectancy - frustration hypothesis was not supported by the data from this study. Only one of the measures designed to test this hypothesis resulted in data which exhibited changes in the predicted direction and these differences were non-significant.

As described, the expectancy-frustration hypothesis predicts that subjects, after viewing a model experience 100% positive reinforcement, will become frustrated if their own attempts do not result in the same high percentage of positive results. Previous research investigating this hypothesis involved simple modeled tasks such as dropping a marble in a hole and then assessing the observer's persistence in imitating the observed behavior. Results from these studies were conflicting with each other regarding the effect of vicarious positive reinforcement upon imitation and extinction.

The present study attempted to evaluate the effect of vicarious partial reinforcement upon a behavior considerably more complex than dropping marbles - the process of decision making. Not only was the behavior more complex, but the occurrence of the subjects' imitation of that behavior in their homes could not be assured.

The measure in the present study which was most similar to that of previous studies in measuring persistence at the behavior was "advocacy of participation in an alternative activity vs. television viewing." This tested the subjects' persistence in advocating selection of the alternative activity in the face of non-positive consequences. The results of the present study showed no significant differences for either treatment group although the trends of the data did follow predicted directions.

Recall from the unit did occur. Subjects were able to reporduce with accuracy the content of self-verbalization exhibited by the model. The predicted behavior change which would have displayed increased use of self-verbalization did not occur.

Stated preference for leisure time activity can be altered by an instructional unit; 100% vicarious reinforcement is a more effective strategy in achieving immediate and enduring stated preference for alternative activities. However, this stated preference was not carried out behaviorally. Although treatment groups did increase participation in alternative activities, there was no significant group main effect.

A major conclusion to be drawn from this study is that while it is possible to effect desired changes in stated preferences, these changes were not borne out behaviorally.

C. Implications for Future Research:

1. It is suggested that to increase the probability of greater use of self-verbalization, the instructional unit clearly should relate the reinforcing outcomes to self-verbalization. To test the effect of vicarious partial reinforcement upon self-verbalization, the model might say (following participation in the alternative activity): "I'm really glad I took the time to consider a number of activities. It is good to ask myself questions before deciding what to do. Because I took the time to ask myself questions before deciding what to do, I had a good experience." Attention would then be focused more directly on the process of self-verbalization and not on the resulting behavior.

Future research might also attempt to isolate the effect of vicarious partial reinforcement upon self-verbalization. For this, a treatment group would be required in which the model was rewarded for self-verbalizing without the intermediate step of participating in the alternative activity.

2. A major contribution of this study was the test of the expectancy - frustration hypothesis away from the controlled laboratory environment. The difficulty encountered in doing so (i.e., uncertainty that the subjects would attempt the behavior in their own homes) might be a deterrent for future research in this area, given lack of favorable results in this study.

With greater control over the imitation process, the results may have been more favorable. This control would, of course, limit generalizability. Future field studies may examine ways of perfecting the methodology used in the present study. Perhaps a medium could be found which would allow for the greater control of laboratory experimentation but not sacrifice generalizability. This might involve a simulation of the home environment in which subjects are asked to make decisions regarding television use.

3. A fourth implication of this study for future research is that it demonstrates the need to corroborate expressed attitudinal changes with behavioral data. As was noted, subjects' expressed prference for alternative activites changed in the desired direction while behaviorally there was no significant difference among groups. It would appear that the treatments were effective in promoting the desired stated attitudinal change. This shift may have occurred more as as result of a desire on the subjects' part to express attitudes which were in accordance with the objectives of the instructional unit than as an accurate reflection of a true attitudinal change.

It is recommended that research in this area test for three levels of effect: recall, stated attitudinal change, and actual behavioral change. Desired effects in one area do not necessarily imply effects in another.

5. It is recommended that future studies focus more narrowly upon one or another area of interest explored in this study: 1) use of self-verbalization, or 2) reduction of viewing hours. Once results are obtained concerning an effective method of creating greater use of self-verbalization, that method may be studied in relation to its effectiveness in reducing number of viewing hours.

6. It is also recommended that the greater percentage of vicarious reinforcement unit be reduced from 100%. This was viewed as unrealistic by some of the subjects in this treatment group.

D. Implications for Practitioners

1. A major contribution of both instructional units was the introduction of the advisability of considering goals in making decisions. It was clear to the researcher from student comments that not only had the children not been considering goals in making decisions, most of them did not know what a goal was. The unit introduced to them the concept of short and long term goals. In addition, it was effective in generating discussion of pro and anti-social methods of solving problems. Further study is recommended, however, to discover methods of teaching children to incorporate that knowledge into their own behavior.

2. Teaching children to make decisions regarding what and when to view television is becoming part of many school curricula. The instructional unit designed for this study was well-received by the teachers, administrators,

and the children who participated in the study. Testimonials from the children and teachers were evidence of this. The stronger points of the unit were the consideration of goals in decision-making and the discussion of pro- and anti-social television. Although the results regarding this study were generally non-supportive of the theories posited, the instructional unit was useful in introducing these ideas to the children.

Viewing of television has not declined; children's perception of reality is distorted by the types and amount of programming they are viewing (Gerbner, et.al., p. 1). With this in mind, teaching children how to make decisions about what and when to view warrants further study and should be studied in the school environment.

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APPENDIX C

SAMPLE OF "HOURS DATA" COLLECTION INSTRUMENT

Table 14. Posttest 1: Report of accurate recall of model self-verbalization.

		Accuracy of Recall	
		Accurate	Inaccurate
Group 2	Frequency	17	1
	Percent	94.4	5.6
Group 3	Frequency	17	1
	Percent	94.4	5.6

χ^2 = .53, df = 1, significance = .47.

Table 15. Posttest 2: Report of accurate recall of model self-verbalization.

		Accuracy of Recall	
		Accurate	Inaccurate
Group 2	Frequency	16	2
	Percent	88.9	11.1
Group 3	Frequency	17	1
	Percent	94.4	5.6

APPENDIX A

FIGURES

Class 1 (Control Group)	Class 2 (T_1)	Class 3 (T_2)
$n_1 = 20$	$n_2 = 21$	$n_3 = 25$
Ralya School	Murphy School	Wilkshire School

Figure 1. Classes, schools, and number of children per class.

(Design over Measures)
Point in Time of Measurement

(Design over Subjects) % of Vicarious Reinforcement	Pretest $V_2 \ldots V_5$	Posttest 1 $V_1 \ldots V_5$	Posttest 2 $V_1 \ldots V_5$
G_3*			
G_2**			
G_1***			

* 50% positive consequences, 50% negative consequences
** 100% positive consequences
*** Control

Figure 2. Variable matrix for variables 1 - 5.

Number of Factors in Design over Measures - 1	Levels in Factor 1 - 3
Number of Factors in Design over Subjects - 1	Levels in Factor 1 - 3

Variables/Measure Point: $0_1 = 4$, $0_2 = 5$, $0_3 = 5$

V_1= recall of self-verbalization

V_2= use of self-verbalization

V_3= advocacy of selection of TV or alternative activity

V_4= reasons for advocacy of selection of TV or selection of alternative activity

V_5= preference of TV versus alternative activity

(Design over Measures)
Point in time of Measurement

(Design over Subjects)
% of Vicarious Reinforcement

	Pretest $V_6 \ldots\ldots V_7$	Posttest 1 $V_6 \ldots\ldots\ldots\ldots V_7$	Posttest 2 $V_6 \ldots\ldots\ldots\ldots V_7$
G_3*			
G_2**			
G_1***			

*50% positive consequences, 50% negative consequences
**100% positive consequences
***Control

Figure 3. Variable Matrix for variables 6-7.

Number of Factors in Design over Measures - 1 Levels in Factor 1 - 2
Number of Factors in Design over Subjects - 1 Levels in Factor 1 - 3
Variables/Measure Point: $O_1 = 2$, $O_2 = 2$, $O_3 = 2$.

V_6= number of hours spent in alternative activity

V_7= number of hours spent viewing TV

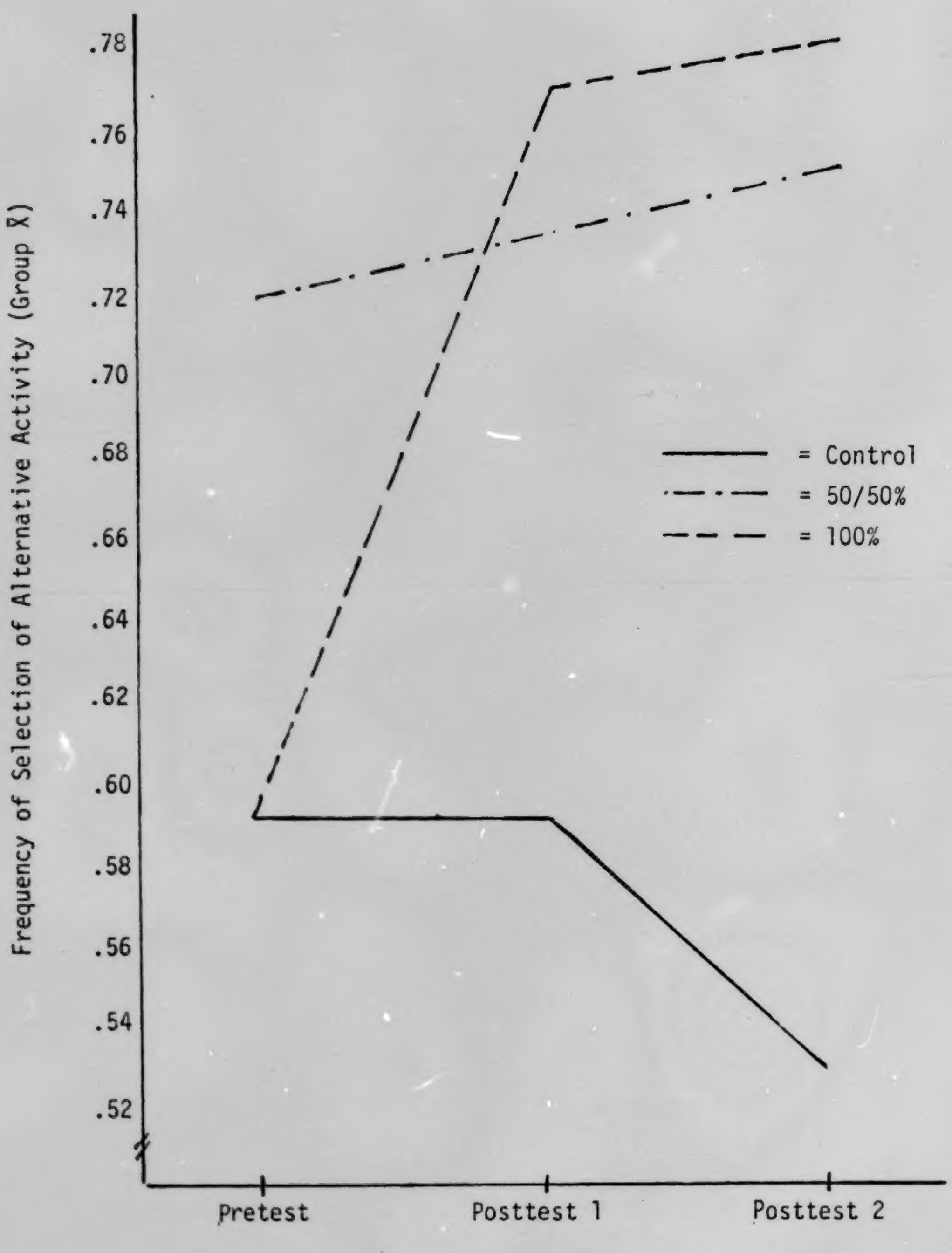

Figure 4. Television viewing versus alternative activity.

APPENDIX B

TABLES

Table 1. Reliability coefficients for dependent measures.

Variable	Alpha Coefficient
I. Preference for leisure time activity	.75
II. Advocacy of choice of activity	.75

Table 2. Percentage of agreement of assignment of responses to categories.

Variable	% of Agreement
I. Recall of self-verbalization	100%
II. Reasons for advocacy of selection of TV or alternative activity	90%

Table 3. Use of self-verbalization: pretest.

		No	Yes
Group 1*	Frequency	12	8
	Percent	60	40
Group 2	Frequency	9	9
	Percent	50	50
Group 3	Frequency	5	13
	Percent	27.8	72.2

$x^2 = 4.09$; df = 2; significance = .13

Table 4. Use of self-verbalization: posttest 1.

		No	Yes
Group 1*	Frequency	9	11
	Percent	45	55
Group 2	Frequency	5	13
	Percent	27.8	72.2
Group 3	Frequency	4	14
	Percent	22.2	77.8

$x^2 = 2.49$; df = 2; significance = .29

Table 5. Use of self-verbalization: posttest 2.

		No	Yes
Group 1*	Frequency	9	11
	Percent	45	55
Group 2	Frequency	7	11
	Percent	38.9	61.1
Group 3	Frequency	4	14
	Percent	22.2	77.8

$x^2 = 2.26$; df = 2; significance = .32

*Group 1 = control; Group 3 = 50% positive, 50% negative consequences; Group 2 = 100% positive consequences.

Table 6. Pre and post treatment mean scores for preference for leisure time activity.

	$\bar{X}_{pretest}$	$\bar{X}_{posttest\ 1}$	$\bar{X}_{posttest\ 2}$	N
Group 1*	.59	.59	.53	20
Group 2	.59	.77	.78	18
Group 3	.72	.73	.74	18

*1 = control; 3 = 50% positive, 50% negative consequences; 2 = 100% positive consequences.

Table 7. Repeated measures analysis of variance for preference for leisure time activities.

Source of Variation	Sums of Squares	df	Mean Squares	F	P
Groups	.94	2	.47	2.86	> .01
Subjects within groups	8.74	53	.16		
Repeated measures	.12	2	.06	3.67	> .01
Repeated measures by group interaction	.36	4	.09	5.42	< .01
Repeated measures by subjects within groups interaction	1.75	106	.02		
Total	11.91	167			

Table 8. Pre and post treatment mean scores for advocacy of selection of activity.

	$\bar{X}_{\text{pretest}}$	$\bar{X}_{\text{posttest 1}}$	$\bar{X}_{\text{posttest 2}}$	N
Group 1	.56	.49	.59	20
Group 2	.60	.51	.54	18
Group 3	.61	.74	.58	18

Table 9. Repeated measures analysis of variance for advocacy of selection of activity.

Source of Variation	Sums of Squares	df	Mean Squares	F	P
Groups	.34	2	.17	.55	> .01
Subjects within groups	16.21	53	.31		
Repeated measures	.01	2	.01	.14	> .01
Repeated measures by group interaction	.40	4	.10	2.64	> .01
Repeated measures by subjects within groups interaction	4.04	106	.04		
Total	21.00	167			

Table 10. Pre and post treatment mean scores for hours of television viewing.

	$\bar{X}_{pretest}$	$\bar{X}_{posttest\ 2}$	N
Group 1	18.36	14.96	20
Group 2	19.72	14.96	18
Group 3	18.36	13.60	18

Table 11. Repeated measures analysis of variance for hours of television viewing.

Source of Variation	Sums of Squares	df	Mean Squares	F	P
Groups	.01	2	.004	.15	> .01
Subjects within groups	1.49	53			
Repeated measures	.10	1	.10	27.96	< .01
Repeated measures by group interaction	.003	2	.002	.45	> .01
Repeated measures by subject within groups interaction	.19	53	.004		
Total	1.80	111			

Table 12. Pre and post treatment mean scores for hours spent in alternative activities.

	$\bar{X}_{pretest}$	$\bar{X}_{posttest\ 2}$	N
Group 1	12.24	19.04	20
Group 2	14.28	19.04	18
Group 3	15.64	20.40	18

Table 13. Repeated measures analyses of variance for hours spent in alternative activities.

Source of variation	Sums of Squares	df	Mean Squares	F	P
Groups	.02	2	.01	.43	> .01
Subjects within groups	1.34	53	.03		
Repeated measures	.17	1	.17	34.18	< .01
Repeated measures by group interaction	.01	2	.003	.49	> .01
Repeated measures by subjects within groups interaction	.27	53	.01		
Total	1.80	111			

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TITLE: Bibliography of Pictorial Research Appearing in
Selected Journals in 1980

AUTHOR: W. Howard Levie

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W. Howard Levie
Audio-Visual Center
Indiana University
Bloomington, IN 47405

Bibliography of Pictorial Research Appearing in Selected Journals in 1980

Pictorial research is defined as:

> Research in which the use of pictures as experimental stimuli is central to (not incidental to) the researcher's hypotheses, and
>
> research in which internal imaginal processes are presumed to be activated, no matter what the nature of the experimental stimuli.

This bibliography was compiled by looking through the 1980 issues of 125 journals in psychology, education, and communications. We (Diane Jung, Richard Lentz, Michael McAnnaly, Tim Miskell, and myself) found 260 articles. Most of them report experimental data, although a few discussion and review articles are included.

Rather than listing all 260 articles in alphabetical order, we sorted them into the following broad categories:

Iconic Memory Page 1
Recognition Memory 1
Memory Models and Miscellaneous Learning 3

Picture Perception:

  Attention and Scanning 6
  Interpreting Features and Cues 7

Mental Imagery 10
Cognitive Maps 12
Brain Laterality 13

Individual Differences 13
Aesthetics and Affective Responses 15
Media Studies 16

Many studies could have been placed in more than one category. So, for example, if you are interested in individual differences, the section beginning on page 13 will lead you to 29 studies. There are, however, more studies on this topic in other sections of the bibliography.

The bibliography is far from being exhaustive. When we made our search some journals were being bound, some issues were missing from the shelves, and we doubtless overlooked some important articles. Other resources such as ERIC, convention papers, and books are not included.

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Reconstructing the History of Educational Technology Provides Us with New Models of Research

A Paper Selected for Presentation to the Research and Theory Division. 1981 AECT Convention

Jeffrey Lukowsky
University of Wisconsin - Madison

IR009572

ABSTRACT

This paper examines the tradition of research within the field of educational technology and cites problems endemic to the dominant research methods. It is suggested that a reexamination of the history of the field has intrinsic merit and is necessary at this time; furthermore, historical analysis may assist in the development of new research methods. Three types of historical explanation are cited and rejected as inadequate. The paper suggests two general cognitive frameworks in order to analyze the history of research in educational communications. It is recommended that the traditional paradigm, technical cognitive research, has severe limitations, and a second paradigm, practical cognitive research, be added to the domain of the field. Definitions and examples of both cognitive strategies are described.

I.

There would be little disagreement among scholars in the field of Educational Communications and Technology that there is a need for new methods of research which could improve the reliability of findings concerning the interaction of instructional technologies with the learner. I use the term "interaction" to denote a large category of research on, and with media, that has characterized the history of research in our field. Allen (1971), Barbatsis (1978), Becker (1977), Clark and Snow (1975), Clark and Salomon (1977), are just a few of the scholars who have noted a number of limitations to media research in the domain of education during the past thirty years. These limitations have occurred in all categories of media research including comparative studies, utilization studies, and attitudinal effect studies (Barbatsis, 1978). The methodological issues have been adequately documented and we are able to describe, with analytic rigor, the limitations and failings of our past research methods, as well as the general cognitive strategies that provided the framework within which these methods were grounded. The succinct focus on problems of methodological design, the intent and range of such designs, and the probable success or failure of experiments in relation to their design goals has given us a fairly good picture of past research problems and future research needs in the field of Educational Communications and Technology.

The growth of statistical methods of analysis in conjunction with newer experimental designs in the educational and social sciences during the past two decades has provided further understanding of the limitations of media research from 1945 to the present. There is, of course, the difficult problem of internal versus external validity and how to provide a compromise, or, better yet, a reframing of that problem so that we can develop generalizable statements concerning the interaction of humans with instructional tools without sacrificing correct standards of analytic rigor and empirical predictability. This is just one of the major categorical problems facing social scientific research and without burdening the reader with other such problems (see authors cited above), we need to note the response to these difficulties.

The analysis of media research problems, and solutions advanced as corrective devices, fall into two prescriptive frameworks. In the major framework one finds a commitment to methodological analysis of past research designs, their limitations and errors, and the proposed response which consists, in most cases, of a more complex operationalization of previous attempts to demonstrate internal validity which depends, primarily, on strict empirical-analytic procedures. For convenience, we can call this the "mainstream" response to methodological problems in social science experimentation (Bernstein,1976; Habermas, 1968). On the other hand, scholars such as Clark and Salomon (1977) state, without hesitation, that a "conceptualization" which requires a reframing of our major guiding orientations to research methods both on, and with media, is a necessary prolegomena to further progress in media technology research in education. This type of prescriptive statement appears ambiguous when compared with precise operations offered as solutions to the problem of internal validity for experimental designs. The ambiguity of the notion of a "reconceptualization" of research methods alerts us to the recognition that imaginative leaps of synthetic analysis are a necessary part of future attempts to concretize the complex linkages between media and learning. When so concretized, that is when new synoptic viewpoints about just what questions we should be asking about media and learning are subsequently connected to advances in educational research methods, the result will be the movement towards ideal research designs and their proper sphere of application. But the development of a paradigm that could lead to a new era in media research would require tenacity and creativity; otherwise, we shall remain within the original atheoretical strategy which gave birth to this field in 1945.

The next two decades are going to present us with enormous challenges. One very important pragmatic decision must be made. In terms of teaching graduate students, and in our collegial dialogues, should we, do we have the courage to enter the ambiguous domain of "reconceptualization" which means, in the ensuing discussion, the process of discovery through difficult terrains of textual interpretation and misunderstanding. In short, to step outside our neat scientific world into the domain of cultural science which depends on entirely different methods for verification of explanatory hypotheses; furthermore, cultural science does not produce nomological knowledge in the same way as do the natural sciences (Habermas, 1968; Williams, 1977). Before approaching this question as well as presenting a new categorical framework for research, let me raise the question of the value of a more complete historical analysis of the field of Educational Communications and Technology. This will serve to clarify the third, and concluding portion of the paper.

II

Few people, especially those in academic and allied disciplines, question the value of historical analysis, both as archival-documentative encoding of a culture's past, and as explanatory schema which describe complex structural relations between the material base of species reproduction and the cultural, or symbolic medium through which the species categorizes, develops, and transmits its objective (hereafter, "technically exploitable") knowledge. Anthropologists and historians use two broad categories to describe the human species' struggle for survival. First, our struggle over and against nature so as to secure biological survival; and the need for the extension of understanding through acts of communication in order that knowledge acquired experientially is codified with as little distortion as possible and with as much dissemination as is necessary for the maintenance of material reproduction. For example, the so-called classical period of the Greek city-states utilized mnemonic devices-- now called the conceptual peg -- to insure minimum distortion of memory. As the species has moved from 400 B.C. to 1980 A.D., we have extended our codes, methods of inquiry, and means of knowledge reproduction through more elaborate systems of education and communication; therefore, scientific knowledge, and its correlative, technical application, is preserved without unnecessary reduplication generation after generation. In short, there is little disagreement about the value of historical analysis for the species as a whole, and for any academic discipline in particular, since academic work is merely a subsystem of the larger system of knowledge production and reproduction.

In our own field, now termed "Educational Communications and Technology", it has become apparent that it is time for us to be more self-conscious of the field's history; we need to preserve and understand its past because the field is beginning to have a significant past. This has not always been the case. Some disciplines, as our own and the discipline termed "mass communications" do not have a long history in comparison, for example, with philosophy or physics. In that sense, it was not crucial that our past be codified into a highly structured historical framework in which we could identify current movements and compare them with past decisions and accomplishments. Nonetheless, it would be an understatement to say that the field of educational communications has had a systematic origin at least since 1945. Now, in 1981, that is 36 years in the past. Given the so-called acceleration in social change, 1945-55 is quite a different period in American history than the period 1970-80. Robert Heinich, Howard Hitchens, and Cal Mether, as well as other leaders in the field, have long recognized the need for such an historical documentation since many of the originators of the field and their work is beginning to disappear. Given the lack of a well-financed archive for the field as well as the fact that the field did not have to be historically oriented until the past ten years, it is not surprising that we suddenly desire to preserve the past. There is little doubt that if we fail to do so, a great deal of information and knowledge will forever be lost to us. The professional association of this field, AECT, should try to avoid that fate even though the costs will be significant in terms of dollar needs.

Archival preservation and analysis however, are quite different matters from historical studies proper. The latter attempt to provide law-like explanations of events that occurred in the past tense. Despite well-known problems concerning the epistemological status of historical "laws" (Dray, 1957; Nagel, 1961), models of historical explanation have become sufficiently rigorous and complex thereby diminishing concern about the validity of conclusions deduced from such models as long as they are correctly applied in the concrete study under consideration. In this field, Educational Communications and Technology, some excellent initial historical work has been accomplished. All of us are familiar with Saettler's book (1968), with the excellent reviews of literature and descriptions of particular episodes in the field's history by Allen (1971), Diane Lembo's doctoral dissertation (1970), and many others too numerous to mention in this short paper. Although this work is of enormous value, it cannot quite be classified as historical explanantion. Narrative description in strict chronological order, and reviews of literature do not constitute the necessary and sufficient criteria for adequate historical explanantion. They are, indeed, descriptions of historical events and often do contain a model (or mixtures of models) of historical explanantion but these models do not meet current standards of historical scholarship. Let me briefly describe the three most prevalent types of historical explanantion in our field and, unfortunately, in so many other disciplines.

The first model is a technological determinism in which instructional media tools are a result of scientific and technical research. Technology is seen as having an inner dynamic of its own, and as it produces new inventions, they are taken up and used thereby causing changes in educational and social structures. This model remains at such a simple level that the addition of a

Weberian analysis is not even considered (i.e., technology, despite its inner dynamic, requires planning, coordination, control, etc. The Weberian view has the merits, at least, of being capable of analyzing bureaucratic growth and rationalization of such.) One would think from reading educational theory and research outside the discipline of educational communications and technology that the historians of the latter field would be familiar with a Weberian analysis (Karabel and Halsey, 1977). But this is not the case.

The second, implicit model is a structuralist-functionalist approach in which particular structural factors (e.g., a lack of teachers to meet an unexpected demand) require solutions which are met through emerging, or new functions (e.g., the use of film to teach in the absence of the requisite number of teachers). The history and shortcomings of this model are well known; it is not surprising that it emerges in educational technology since this model dominated during the World War II period.

The third model of historical explananation is an interventionist one in which government and private agencies initiate and implement educational projects.

None of three models described are sufficiently rich to provide us with adequate historical explanations of the complex, and concrete, linkages between technology, learning, and social relations. The concept of intention is absent and the actual history of instructional technology is obscured. Why and how were decisions made to adopt media technologies? On what basis? How and why did the original group of instructional technology researchers decide to frame their hypotheses in the way they did? More importantly, why the peculiar atheoretical cast which the field seems to have adopted from its inception and carries forward to this day? Some theoretical perspective must have existed in order to carry on any research. Did that perspective make choices in favor of some technologies and ignore other possibilities. For example, interactive educational technologies were advocated during the late twenties and early thirties yet quickly disappeared from history in favor of one-direction communication systems. It is frequently stated that the applied nature of the field is the cause of its minimum concern for theory. That proposition is not supported by an anlysis of the periods of formation, 1921-1931, and consolidation, 1932-1945. These periods witnessed methodologists and theoreticians of excellent caliber, including Knowlton and Tilton, F. Dean McClusky, and Frank Stanton who later became president of the CBS Television Network. The decline of serious research grounded in vigorous theory appears to have taken place in the 1950's and I shall not venture an explanantion as to its causes. Suffice to say, along with Gerald Lesser, that the lack of a significant corpus of post-World War II formative research has had a disasterous effect upon current needs in educational media. It is clear that new historical analysis would be of enormous benefit to the field in terms of explaining the field's relationship to the wider educational and social environment. It will also provide us with answers to some of the questions I raised earlier on in the paper.

Although we may all agree as to the general value of newer, more rigorous analyses of the history of the field of educational technology, would it necessarily follow that such work will provide more imaginative and innovative conceptualizations of research methods on, and with media thanwould occur without such an analysis? Intuitively, we would have to answer in the positive. A synoptic vision, or general overview of a discipline which situates highly specific technical competencies within that overview, is more likely to produce a greater body of dynamic literature, and a wider range of experimental procedures than a field which ignores such views and merely reproduces its research paradigms in a historically decontextualized manner. It is the case, however, that the relation between historical analysis and the birth of research methods is one of mere contingency. It is not necessarily the case that a reconstruction of the history of this field, made available to students and practitioners in a systematic manner of distribution and teaching, will lead to reconceptualization of the field to meet the research challenges of the 1980's and 1990's. It is clear however, that many scholars in our field share a belief in the importance of historical analysis to their research dilemmas. For example, Clark and Salomon (1977, p. 105) quote the Freeman experiments and say that it was quite unfortunate that the lessons of those experiments were forgotten.

We can now summarize the discussion of this part of the paper. Historical analysis of our field has intrinsic merit and should be pursued at this time since the field has a significant past. Such analysis will be of enormous benefit to future students and practitioners. A benefit from this work may be the development of new conceptions of media research advanced by investigators who have thoroughly analyzed the field's past research methods and the decisions underlying the choice of particular methods. Now let us turn to one historically oriented model of knowledge development which may provide us with a more cogent viewpoint from which we could analyze the relation between operational research needs and the reconceptualization need for future instructional media research.

III

The history of the human species demonstrates two conclusive generalizations about our struggle for survival. We are constantly oriented, in an instrumental sense, towards an ever increasing understanding of, and control over, nature. From primitive agriculture, to the craft guilds, to modern industrialization, humans always seek increased control of natural processes in order to reduce unpredictable factors which could destabilize or worse, annihilate human social organization. The second historical conclusion follows from our need to acquire knowledge in the objective domain of nature. To wit: as scientific knowledge is accumulated, it must be organized, taught, applied, reproduced, and so forth; therefore, the species develops and refines methods for the extension and presentation of understanding which occurs, primarily through the use of language. Following Habermas (1965) we shall categorize these two processes as related, but distinct human interests in knowledge production and reproduction. The interest in prediction and control of natural events will be termed the "technical cognitive interest"; the interest in the extension and transmission of knowledge will be termed the "practical cognitive interest".

The technical cognitive interest is incorporated within the empirical-analytic sciences. These sciences produce nomological statements that assert conditional predictions about observed events, physical or social. The framework of the empirical-analytic sciences sees reality as the sum total of facts which a collective subject, the community of scientists, can establish as true propositions, expressible in formalized language, which can lead, given initial conditions, to a set of technical recommendations for the control of observed processes.

We do not need a lengthy discourse on the nature of scientific knowledge. The point here is simply to remind us that scientific knowledge is primarily guided by a meta-scientific interest in bringing the environment under control. This does not conflate the traditional distinction between the pure and applied sciences because the pure sciences depend on a strict empiricist interpretation of the world. It is this viewpoint which has made possible the extraordinary technical advances of the past four centuries. The pure sciences, therefore, may not exhibit an instrumental orientation in every instance; nonetheless, the technical cognitive interest remains the primary framework within which scientific practice occurs.

The practical cognitive interest is found in the cultural sciences; e.g., history, literary interpretation, psychoanalysis, and ordinary language analysis. The methodological framework for these sciences is different from the empirical-analytic sciences. The cultural sciences do not construct theories deductively, and experience is not organized with regard to the success of operations. What counts as a fact is provided by the understanding of meaning, not by controlled observation. Our acts of understanding are governed by consensual norms which define reciprocal expectations about behavior and must be understood by two, or more acting subjects. While the validity of technical knowledge statements depend on empirically true or analytically correct propositions, the validity of propositions referring to communicative action is grounded only in intersubjective mutual understanding of intentions and obligations. The cultural sciences therefore, are primarily concerned with symbolic interaction systems, or what we currently call communicative interaction. We explicate acts of communication through an analysis of rules of grammar and social norms which govern interpersonal behavior. The important claim I would like to make is just this: the practical cognitive interest, reflected in symbolic interaction systems, is distinguished from the technical cognitive interest, reflected in the empirical-analytic sciences, in that the former domain cannot be reduced to the latter. This claim needs further explanation and then I shall proceed to discuss the value of this approach for future media research.

A cursory examination of the history of the social sciences exhibits divergent conceptual strategies for analyzing human interaction. Some differences are: the manner of formulating problems, methods of research, choice of categorical framework, the definition of the object domain, and whether or not meaningfully structured language forms are to be taken as objects among other physical objects, or conversely, does the object domain itself only have sense, in the first place, as a meaningfully structured form. The vituperative nature of this debate began to dissipate during the 1930's with the view that there was, and is, only one form of knowledge -- that, of course, being scientific knowledge derived from the use of empirical-analytic procedures. This unity of knowledge viewpoint, associated with various types of positivist thought, seemd to completely destroy the need for any other epistemology than that found within the natural and mathematical sciences. Indeed, positivism held that nothing could count as knowledge unless it could be constructed, in principle, upon the deductive-nomological explanatory framework; thereupon, the great rush to model the science of society upon the methodological approaches of the natural sciences.

Despite the rejection of positivism and the unity of science movement as indefensible meta-scientific theories, enormous gains have been made by adopting the pragmatic component of that position; namely, a behavioral approach to human action including the process of learning.

Unfortunately, we have yet to develop successful measurement operations for "meaning"; that is, how humans understand each other as self-conscious acting subjects. The problem is that we cannot observe actions in the same way that we observe mere behavior. To observe behavior as action, we must relate features of this behavior to rules on which it is based and understand the meaning of these rules. In short, to adequately describe an action implies the understanding of a norm or the corresponding intention. In terms of communicative actions, language usage requires both a cognitive capacity to understand a rule and the preformative capacity to apprehend the universal in new particular instances. Behavioral research designs applied to communicative interactions have been of little value compared to behavioral analyses of human actions other than speech acts.

What are the implications of the foregoing argument for future instructional media research? First, we must relax our dogmatic adherence to a purely behavioral approach to research. After all, the belief that there is only one type of knowledge, deductive-nomological knowledge, is itself a metaphysical dogma. It cannot be proven empirically, or by a logical deductive argument. It is a matter of faith and we like it because it works. But how will traditional media research be received in the future? The current prognosis is not good and the range of questions and problems confronting us could lead to a delegitimation of our field if we fail to respond creatively to the emerging instructional telecommunications environment. To mention just one major problem: recent instructional tool systems are increasingly interactive, or two-way, including multi-point cable systems, teleconferencing, computer conferencing, electronic blackboards, and combinations thereof. Traditional media research experiments and current instructional development methods will be of assistance in maximizing the potential of these technologies; e.g., computer-simulation curricula, individually guided instruction via micro-computer, videotext delivery systems, etc. Nonetheless, we are being asked questions which we cannot answer; furthermore, we do not possess the cognitive strategies in which to frame the questions. The reason is simple. There is rapidly growing interest in communicative competency via the interactive media technologies and the field of educational communications and technology has not developed a tradition of symbolic interaction research; instead, it has relied for the most part, on technical cognitive research. There is no longer any justification for constraining media research within the technical cognitive framework. Indeed, future media research could undergo an exciting rebirth by including stategies and methodologies derived from the practical cognitive interest of the cultural sciences.

It should be recalled that general cognitive strategies, or "knowledge interests" are the viewpoints from which we apprehend reality; in fact, knowledge is only possible because of these meta-empiricial frameworks which guide our epistemological projects. The choice of one cognitive strategy rather than another is based on complex factors. I briefly mentioned some of these factors in part two of the paper including the decision as to the most appropriate methodology for measuring meaningful language utterances. The results of my research demonstrate that technical and practical cognitive strategies are analytically distinct but empirically related. In short, certain contexts will demand the use of one strategy rather than another; other contexts will require unique mixtures of both strategies.

There has been enormous progress in the cultural sciences during the past decade but little, if any of this work has made its way into media research.

The most powerful model of communicative competence, developed by J. Habermas, has already been successfully operationalized by Wiemann (1977). This is but one example of the conjunction of technical and practical cognitive strategies which increased the generalizability of his findings while preserving internal validity.

During the next two decades, we can anticipate questions, problems, and needs which heretofore have not been a significant aspect of our field. There will be increasing concern for methods that improve communicative competence via multi-point interactive communication systems. The focus will not be upon methods of cognitive acquisition. Learning theory, perception theory, information processing models, instructional development methods, etc. have a long tradition and are well-situated; that work, of course, will continue and outstanding issues still remain unsolved and must be solved in order to improve learning. Nonetheless, a new arena of research must begin alongside our mainstream research. Bliss (1980) has shown that the majority of the Canadian experiments in medical learning via various types of interactive instructional communication systems did not meet the anticipated goals. The crucial variables concerned problems of distorted communication; i.e., questioning the authenticity of the speaker, inappropriateness of comment, uncertainty as to entry and exit from group discussion, etc. The results are not surprising; teleconferencing experts have been frustrated for years attempting to develop efficient communication protocols. The more mechanistic protocols increase order within the group but decrease participation and learning. I believe that the solution can be found through symbolic interaction research rather than traditional "attitudinal" research situated within the technical cognitive paradigm. After all, we can only benefit from such research attempts. It will increase the range of our field during the the next two decades and provide us with more work in the emerging "third wave" communication systems. Cultural science is no longer an ancient metaphysics. It has emerged with powerful new approaches including semiotic analysis. To be certain, ambiguities remain in its methods but why be frightened of ambiguity? The challange to resolve ambiguity will bring out the best in all of us and lead to an exciting future for our field.

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PHOTOGRAPHY TO ENHANCE AESTHETIC SKILLS[1]

Marina Stock McIsaac
Assistant Professor, Educational Technology
Arizona State University
Tempe, Arizona

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Photography to Enhance Aesthetic Skills

Two students photograph the same subject. One photograph communicates a heightened sense of reality, the impact of the decisive moment and is more interesting to the viewer. The other is technically well done, but communicates none of the aforementioned aesthetic qualities. Is the unequal quality of these students' photographs due to technical instruction? How does the introduction of instruction in aesthetics affect the photographs of students having high or low spatial abilities? The photographic statement involves a cognitive process, a symbolic manipulation of information and requires a basic level of technical competence in order for information to be communicated visually. What types of learners benefit most from this visual production process?

In an effort to answer this and related questions, a study was conducted (McIsaac, 1980) to investigate the effects of instruction in photography on fourth and fifth grade students. It has long been recognized that photography in the classroom is highly motivating and offers a unique vehicle for communicating ideas visually. Studies such as the Milford Visual Communications Project (Fransecky, 1973) and the Green Chimneys School Project (Ross, 1972) attempted to establish the importance of photography in the school curriculum. These studies suffered from a lack of concrete identifiable variables from which to collect data.

The present study was an attempt to isolate variables which can be both observed and evaluated in photographs and for which instruction can be designed. An effort was made to identify which level of spatial ability benefits most from these differences in photographic instruction.

One purpose of the study was to examine the relationships among technical and aesthetic qualities in students' photographs as well as students' spatial abilities. In addition, photographic improvement within each level of spatial ability was examined to determine whether the improvement occurred in the lower order technical skills or higher order aesthetic skills. It was anticipated that there would be no spatial ability effect on the improvement of technical skills in photography but that the ability to conceptualize and communicate higher order aesthetic information would be significantly greater among students identified as having high spatial ability.

Photography is a visual medium of communication with inherent characteristics unique unto itself. It is not a direct perception but is a two dimensional symbolic representation of three dimensional reality. The photographic process produces the symbol or representation by creating an image on light sensitive paper. In this study, the skills involved in the photographic process were categorized as aesthetic skills or technical skills.

Technical Skills

Technical skills were those mechanical manipulations required of students to enable them to produce a clear photograph. During the pilot study in a small elementary school, observations were made in order to identify difficulties students might have in taking pictures. Extrapolating from these realistic problems, four technical criteria were identified as those necessary to produce clear images with the Polaroid cameras being used, the EE100 model. Technical criteria were described to the students as 1) Filling the frame 2) Focusing 3) Avoiding camera movement and 4) Avoiding subject movement. These are identified in Table 1 as Tech 1, Tech 2, Tech 3, and Tech 4.

Filling the frame, or composing within the frame, required instructions to students in how to eliminate extraneous background material, how to learn to see as the viewfinder sees, and how to frame the visual statement. Focusing, with this particular model camera, required that the students correctly estimate the camera to subject distance in feet and set the corresponding focusing ring. Holding the camera steady required practice in squeezing a rather stiff shutter. Avoiding subject movement required awareness and planning on the part of the photographer to avoid a blurry image.

These four technical criteria were determined to be essential technical elements in the production of good photographs by students and were incorporated in the lessons for both treatment groups. These four items were also subsequently used as evaluative criteria when students' photographs were later rated by judges.

Aesthetic Skills

Aesthetic skills were defined in this study as those demonstrating the ability to recognize the produce information or artistic material in a creative symbolic way. There are many examples of the presence of aesthetic qualities in photographs. Aesthetics are those qualities which stretch the imagination and present complex ideas. There are countless aesthetic elements, but four were chosen from the literature in photography for this study. They are the ability to create: 1) a heightened interest, 2) a heightened sense of reality 3) a unique point of view and 4) an expression of the decisive moment. These are identified in Table 1 as Aes 1, Aes 2, Aes 3, and Aes 4.

Heightened interest. Creating interest in a photograph can be accomplished in a variety of ways. An emotional statement can evoke humor, sadness, and joy through the artists' individual portrayal of a situation. Excitement or tension is created betwen the photographic image and the viewer. This tension helps recreate experience and affirms the wholeness of the work (Bayer, 1977). Aesthetically this can be done through composition, selection of subject matter or the juxtaposition of other visual elements.

Heightened reality. A sense of heightened reality is described by Ward (1970) as the degree of integrity of meaning evidenced by the visual relationship within the composition. Heightened reality is what Suzanne Langer (1942) describes when she says that art is a semblance which seems charged with reality. It is, in fact, the very essence of what Benjamin (1969) describes as the "aura" or the sense of reality, the authenticity, of a presence in time and space.

Unique viewpoint. A person's unique viewpoint is one which expresses that individual's particular ideas. Jerry Uelsmann, for example, frequently presents his point of view through paradoxes such as elegance and vulgarity (Ward, 1970). Cartier-Bresson does the same through visual contrasts (Henri Cartier-Bresson, 1976).

Decisive moment. The decisive moment is that precise time at which moving elements are in balance. The phrase is associated with Cartier-Bresson's search for universal harmony in the flux and movement of images. When the instant is right, the rhythm of the universe creates such a decisive moment. Aesthetically, this moment results from an intrinsic blend of figure and setting which presents perfect equilibrium.

Experimental Variables and Instrumentation

The principal independent variable of interest in this study was spatial ability as measured by the SRA Space Relations Test. Space relations is "the ability to visualize how parts of objects fit together, what their relationships are, and what they look like when rotated in space" (Thurstone, 1962). The ability to form spatial relationships is considered a crystallized or fixed ability, as opposed to a fluid or changing ability.

The dependent variables chosen were scores on the four previously mentioned technical skills and scores on the four aesthetic skills. Scores resulted from the evaluation of the subjects' photographs by a panel of judges. Post-treatment photographs were judged for improvement on the four technical and four aesthetic criteria.

Methodology

A quasi experimental nonequivalent control group design for intact groups was used in this study. Classes were taken as a group and stratified random assignment to treatments was made within sex and spatial ability as measured by the SRA Space Relations Test. Sixty-six fourth and fifth graders received instruction, participated in photographic exercises and took photographs of various themes of their choice which were ultimately evaluated by a panel of judges for technical and aesthetic improvement. The two treatments, Treatment One and Treatment Two were as follows. Treatment One consisted of technical instruction in photography, photographic exercises and materials developed for instruction in aesthetic concepts. Treatment Two consisted of technical instruction in photography, photographic exercises and general perceptual exercises. The SRA Space Relations Test was administered and division by median scores then determined high or low spatial ability.

Sets of experimental materials were developed by the investigator for both treatment groups (McIsaac, 1980). The study was conducted during six sessions of 40 minutes each. Students met twice a week for three weeks. Field procedures for the six sessions are outlined in Figure 1. Two independent variables, level of spatial ability and treatment condition were subsequently examined to determine whether there were mean differences between students' technical and aesthetic performance scores when student produced photographs were evaluated by a panel of judges.

Five judges rated fifty-five pairs of photographs for each of the eight criteria, four of which were technical and four aesthetic. A score was either one or zero. The investigator was looking for the dicotomous situation of improvement or no improvement. Therefore, only difference scores were obtained. An item received a score of one if the second photograph showed improvement in a selected criterion. If the second photograph was the same or worse on that item, a zero was recorded. Since some students' second photographs were worse than the first, it was not evident to the judges which were pre- and which were post- photographs. Pairs of photographs were randomly projected on a screen and could not be identified as belonging to Treatment One or Treatment Two. A student's score on each of the eight criteria was the sum of ones and zeros assigned by all five judges. Individual as well as total aesthetic and technical scores were therefore obtained for each student.

In order to ascertain inter-judge reliability, alpha coefficients were obtained. The alpha reliability coefficient for the twenty technical scores, which represented five judges times four technical criteria, was .91. The alpha level for the twenty aesthetic scores was .85. These figures indicate that both technical and aesthetic ratings across five judges were consistent.

Results

Factor Analysis of Technical and Aesthetic Items

In order to determine whether the four technical and four aesthetic criteria were indeed independent and separate items, a factor analysis was performed on composite scores, scores summed across five judges. As can be seen from Table 1 all four aesthetic items receive heavy weightings, and accounted for the greatest proportion of the variance. The first factor which emerged was the aesthetic factor, in which the items Aes 1 to Aes 4 were most heavily weighted. With an Eigenvalue (Kerlinger, 1973) of 3.43 the aesthetic factor accounted for 43% of the variance. The second most important factor was heavily loaded in the four technical areas and accounted for an additional 32% of the variance. Together those two factors accounted for 75% of the total variance (Table 1).

Only one item was weighted differently. Tech 1, filling the frame, loaded about equally on both factors. Filling the frame is apparently a technical as well as aesthetic consideration. To ease subject matter interpretation, it was decided to identify this item as a technical criterion. Other factors with Eigenvalues less than one were dismissed as unimportant factors. The factor analysis suggests that technical and aesthetic qualities are indeed separate characteristics which should not be treated as one composite score. Both technical and aesthetic factors are relatively independent of each other. This confirmed the investigator's decision to separate the factors in this way. In addition to the factor analysis, Q-Q plots or normal scores plotted against actual scores, indicated that student scores on all eight criteria were normally distributed.

Aesthetic Improvement

Results of an analysis of variance indicated that there was a significant difference between subjects' total aesthetic improvement scores due to treatment. The main effect for treatment, which was significant at the $p = .015$ level, indicated that students in Treatment One scored significantly higher than students in Treatment Two (Figure 2). Photographs taken by students who participated in technical and aesthetic instruction were evaluated as better and more visually interesting than photographs taken by students who were given technical and perceptual instruction. Aesthetic improvements were visible in the photographs from Treatment One but not from Treatment Two when evaluated by the panel of experts. This supported the investigator's premise that aesthetic concepts can be identified, taught and evaluated through examination of visual information in photographs.

Results from the ANOVA indicated that there was no difference in total aesthetic improvement due to spatial ability. The power of the test was adversely affected by the loss of seventeen percent of the participants over the three week treatment period. Since the power of the test was not great ($1-B = .55$), and sample sizes were not large (Table 2), differences may have been difficult to detect. Among the limitations affecting sample size were the number of cameras available.

Technical Improvement

Results of an analysis of variance on total technical scores revealed that there was a main effect for spatial ability which was significant at the $p = .024$ level (Table 2). It appeared that the aesthetic components of instruction influenced total technical scores, and that training in aesthetics may have supplemented students' technical knowledge (Table 2).

Total aesthetic improvement had been hypothesized to occur with high spatial ability students but occurred in low spatial ability students when technical skills were measured. Low spatial ability subjects benefited most from technical instruction which included aesthetics. Neither of the other three conditions benefited as much (Figure 3).

Instruction in aesthetics may supplement low spatial ability students' technical skills by giving them a better understanding of spatial relationships in photography.

Summary

Findings from this research indicate that when the instructional techniques employed in this study are used, photography facilitates the communication of technical and aesthetic skills. Results showed that there was a significant difference in aesthetic improvement scores between treatment groups as demonstrated through students' photographs. It was ascertained that there are aesthetic concepts which are observable in photographs and which exist independent of technical criteria. These concepts can be communicated and evaluated in students' photographs. There was no indication in this study of spatial ability differences in aesthetic scores. However, there was a significant main effect for spatial ability among total technical scores, resulting in significantly improved technical scores among students of low spatial ability.

Results from this study indicate that simply giving students a camera and telling them how to use it is not enough. In all instances, students performed better when aesthetic concepts were imbedded in the instruction. For students of low spatial ability, such aesthetic instruction allowed them to perform significantly better on technical tasks.

The ability to communicate information both technically and aesthetically may adress different types of learner needs and abilities. Further research into the effectiveness of photography as a medium of instruction should investigate which type of instruction in photography best addresses the needs of which type of learner.

Table 1 Factor Analysis Results

Rotated Loadings

	Factor 1	Factor 2
Technical characteristics		
Tech 1	.56775	.51364
Tech 2	.01864	.96358
Tech 3	.06584	.91376
Tech 4	-.01954	.92155
Aesthetic characteristics		
Aes 1	.80762	.19389
Aes 2	.88331	-.02975
Aes 3	.78163	.06760
Aes 4	.84273	-.14148

Factor	Eigenvalue	pct. of var.	cum. pct.
1	3.43193	42.9	42.9
2	2.58867	32.4	75.3
3	.65350	8.2	83.4
4	.47325	5.9	89.3
5	.39628	5.0	94.3
6	.22330	2.8	97.1
7	.14808	1.9	98.9
8	.08499	1.1	100.0

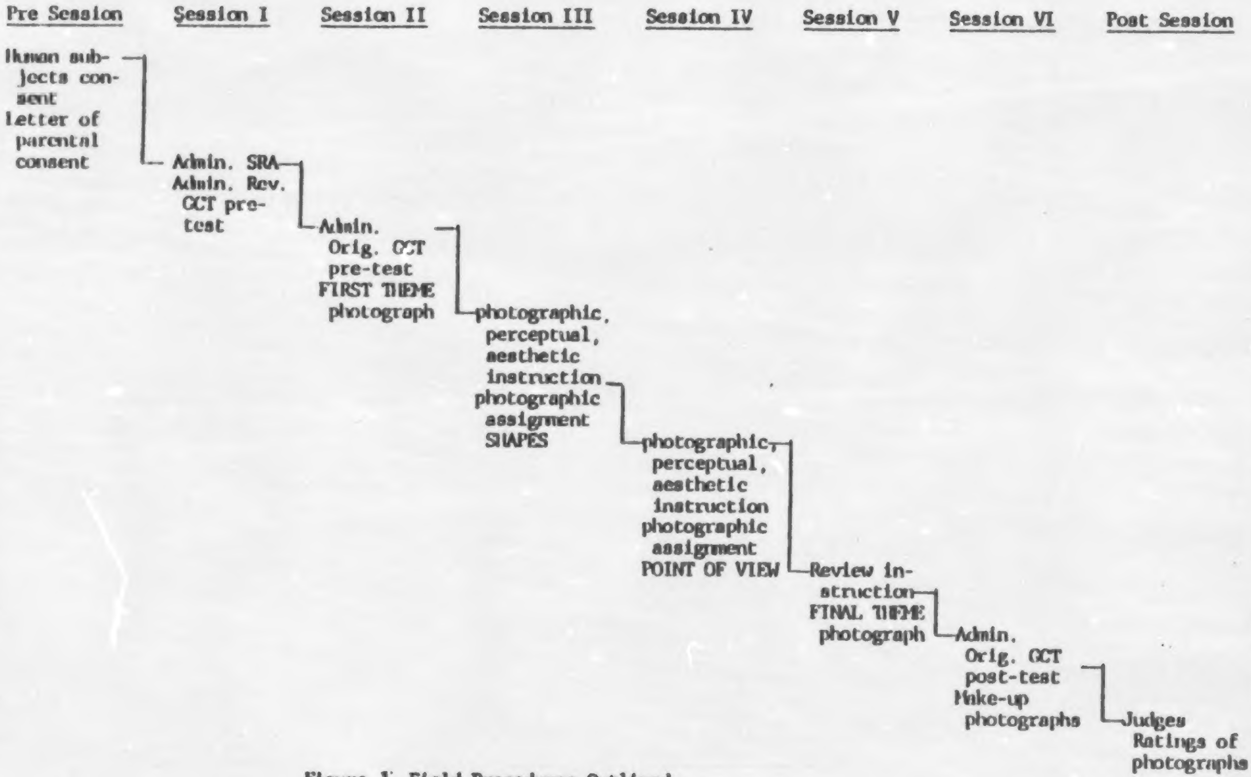

Pre Session
Session I
Session II
Session III
Session IV
Session V
Session VI
Post Session
Human subjects consent
Letter of parental consent
Admin. SRA
Admin. Rev. GCT pre-test
Admin. Orig. GCT pre-test
FIRST THEME photograph
photographic, perceptual, aesthetic instruction
photographic assignment SHAPES
photographic, perceptual, aesthetic instruction
photographic assignment POINT OF VIEW
Review instruction
FINAL THEME photograph
Admin. Orig. GCT post-test
Make-up photographs
Judges Ratings of photographs

Figure 1 Field Procedures Outlined

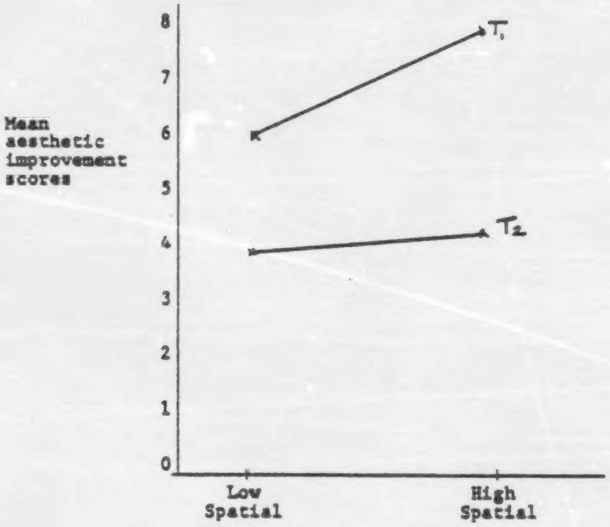
Table 2

Analysis of Variance Table for Total Technical Scores

SOURCE	DF	SS	MS	F	p
Treatment	1	104.042	104.042	3.694	.060
Spatial Ability	1	153.050	153.050	5.434	.024
Treatment by Spatial Ability	1	58.478	58.478	2.076	.156
Error	51	1436.480	28.166		
Total	54	1759.345	32.580		

Mean, Standard Deviation, Variance, Frequency of Total Technical Scores for Each Cell of the 2X2 Factorial Design

	Mean	Std. Dev.	Variance	Freq.
Treatment One	8.1000	5.5358	30.6448	30
Low Spatial Ability	7.5000	5.8652	34.4000	16
High Spatial Ability	8.7857	5.2650	27.7198	14
Treatment Two	5.0400	5.5639	30.9567	25
Low Spatial Ability	2.6429	3.1770	10.0934	14
High Spatial Ability	8.0909	6.5491	42.8909	11



Aesthetic Improvement Scores in Photographs

Significant differences due to treatment but not due to spatial ability.

Analysis of Variance Table for Total Aesthetic Scores

SOURCE	DF	SS	MS	F	p
Treatment	1	111.471	111.471	6.375	.015
Spatial Ability	1	15.033	15.033	.860	.358
Treatment by Spatial Ability	1	7.205	7.205	.412	.524
Error	51	891.708	17.484		
Total	54	1025.636	18.993		

Figure 2.

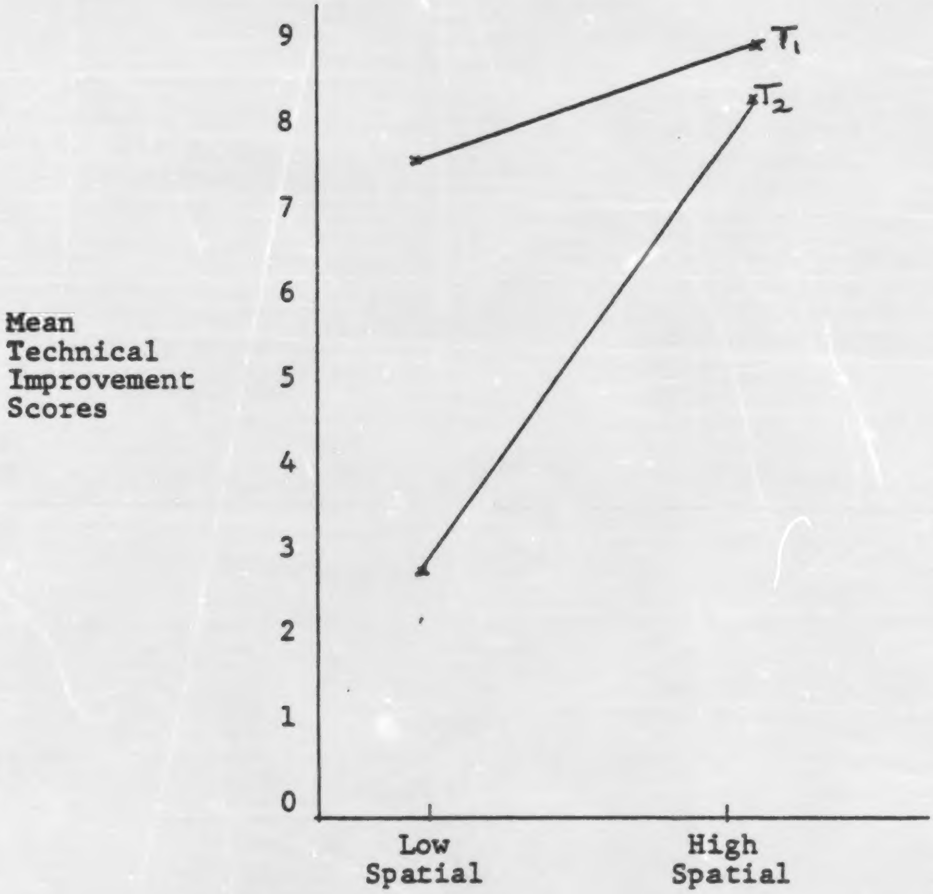


Figure 3. Technical Improvement Scores in Photographs
Significant differences due to spatial ability but not due to treatment.

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ED207507

Relationship Between Eye Movement and Cognitive Information Acquisition Utilizing an Unobtrusive Eye Movement Monitoring Device

Larry L. Nesbit
Mansfield State College
Mansfield, Pa. 16933

IR 009574

Abstract

This research was designed to test the relationship between the number of eye fixations and amount of learning as determined by a criterion referenced posttest. It was found that there is a correlation between the amount of learning and the number of eye fixations because the subjects who had the highest number of fixations had the highest posttest scores. The level of visual complexity, i.e., simple, shaded, or realistic photographs, did not influence the fixations, but intelligence did with the most intelligent subjects having the highest number of fixations.

Relationship Between Eye Movement and Cognitive Information Acquisition Utilizing an Unobtrusive Eye Movement Monitoring Device

All ages of school students are constantly being exposed to more and more visuals with the anticipated result, at least on the part of educators, that an increase in learning is taking place (Wolf, 1970). Unfortunately, however, the increased use of illustrations in textbooks, slides, etc. is more often based on common sense guidelines and artistic notions than on experimental evidence (Fleming, 1969).

A considerable amount of research, however, has been conducted on the role of visuals in promoting more efficient learning. Initially the work could be best described as picture preference studies which often compared instruction with pictures to instruction without any visual illustrations (McClusky and McClusky, 1924; Goodman, 1942). It has only been more recently that any systematic study of visuals (Dwyer, 1975) has been undertaken. In Dwyer's investigation, he compared the results of a posttest with different types of visuals, i.e., simple line drawings, shaded line drawings, and realistic photographs with how the instruction was presented, i.e., television, slides, or textbooks and whether or not the instruction was self-paced or controlled. Basically it was found that there was an interaction between the type of drawings viewed and whether the instruction was self-paced or presented at a fixed rate as shown by the scores on the criterion posttest. While this type of data is very valuable, it may have provided incomplete information of how much the subject actually learned from viewing the stimulus materials due to individual differences in answering the questions on the posttest.

Within the past few years the use of eye movement indices, i.e., the number of fixations, has been utilized as another measure of cognitive processing. For instance, Loftus (1972) has found that the number of fixations made by a subject while he/she initially viewed a picture was the best indicator of subsequent picture recognition. Perhaps Wolf (1970) states the case for using eye movements as an index of learning most succinctly:

> Eye movements present an unusual opportunity for finding out the reactions of viewers to a visual stimulus. They give information on where the subject is looking, how long he looks at a particular area, how often he looks at particular objects and the types of movements he makes. . . .This reaction is different from giving the subject a printed test or asking him in an interview what he has learned from the stimulus. (p. 13)

Thus, the present research was motivated by a desire to determine if it is the visuals or the learner which influenced the number of eye fixations or the amount of learning as determined by the posttest scores. In this particular study the eye movements were collected in a naturalistic setting from subjects who were unaware that it was their eye movements which were of primary interest because the unobtrusive HEL Oculometer was utilized.

Specifically, the present study is designed to answer the following questions:

1. Are differences in eye movement indices related to the posttest score?

2. Do differences in eye movement indices of subjects depend on the various types of visuals or on varying categories of intelligence?

3. Do differences in the posttest scores of subjects depend on the various types of visuals viewed or on varying categories of intelligence?

Eye Movements and Visuals

According to earlier research, there are basically two factors which may influence the looking behavior of subjects: (a) stimulus materials themselves and (b) the intelligence level of the viewer.

Perhaps the area which has received the most attention from researchers interested in eye movement and stimulus variables is with regard to complexity, novelty, and affective value. Loftus (1976) indicated that since Buswell's (1935) early work it has been noted that a viewer will be attracted to the most informative areas of a picture. As Loftus pointed out this theory is supported by logical reasoning because if one is shown a picture of a city skyline, the viewer will focus his/her attention on the buildings, not on the area of clear blue sky. More recently Faw and Nunnally (1967) conducted a series of experiments with college students in which they found that the subjects attended more to the complex, and the more novel pictures. The study was replicated by Faw and Nunnally (1968) with elementary grade school children with the same results.

In another study utilizing college students as the subjects, Mackworth and Morandi (1967) found that the subjects fixated squares of pictures which had previously been rated as high in information more than pictures which were ranked low. A final study which has dealt with the issue of complexity is that of Zusne and Michels (1964). They found that polygons which were more complex drew more eye fixations than did straight lines. The issue of complexity, however, is not as well defined as the above research would indicate. Wolf (1970) indicates that complexity seems to attract more eye fixations, but only up to a point. When the stimulus becomes extremely complex, the subjects may tend to avoid the stimuli or to fixate centrally.

Just as the complexity issue is clouded with contradictory findings, the same situation is true when one analyzes the results of picture recall tests. It was mentioned earlier that Loftus (1972) found that the more times a subject fixated a picture, the more likely he/she would be able to recall it later. Tversky (1974), however, found different results. In her study, the subjects who fixated the stimulus materials fewer times had the highest recall on later memory tasks.

Intelligence and Eye Movement

According to some research, the intelligence level of the viewer will influence how he/she gazes at the stimulus material. Anderson (1937) found a difference in the eye movements of children who were good and poor readers. However, when he statistically isolated the factor of intelligence, the difference was no longer significant. Therefore, it seemed that intelligence was a contributing variable. Guba, et al. (1964) found a sizable correlation between some of the eye movement indices of subjects and intelligence as measured by the California Test of Mental Maturity.

In a study conducted by Wolf (1970), it appeared that there was a relationship between eye movement indices of duration and number of fixations, but the results were contaminated by the stimulus variable of motion. However, there was a direct relationship between intelligence and scan pattern since the high IQ subjects maintained flexibility in their scanning patterns dependent of the stimuli, whereas the low IQ subjects tended to use a static scan pattern.

Visuals and Learning

The research in the area of learning from visuals may be best characterized by the term multifaceted. During the period of time when much of the early pictorial research was being conducted, the realistic theories of Dale (1946), Morris (1946), and Carpenter (1953) were the most prominent. All of these theories contend learning will be more effective as the number of cues in the learning situation increases. These theories were generally accepted since they seem to have a firm base in logical reasoning.

Travers (1964) and Broadbent (1958) opposed the realism theories by suggesting that too many cues may tend to impair rather than facilitate learning. Travers and Broadbent advocate

> . . . that human receivers are capable of processing only a portion of the information available in complex realistic events, and the learning may be enhanced when presentations are reduced in complexity so that only the cues relevant to the learning task are provided. (Levie and Dickie, 1973, p. 873)

Dwyer (1975) has completed the most organized and extensive work with visuals to date. His studies have utilized materials consisting of drawings with varied detail, i.e., simple line drawings, shaded line drawings, and realistic photographs, in a unit of instruction presented to subjects from a number of different grade levels. The results of the studies are varied, but the following two conclusions are prominent: (a) the simple line drawings were the most effective when the pace of instruction was fixed and (b) the visuals which were more realistic and consequently contained more detail seemed to promote more efficient learning when the learner could control the pace of instruction.

In light of the past research conducted on the relationship of: (1) visuals and eye movements, (2) intelligence and eye movements, and (3) visuals and learning, the present research was conducted to answer the following research hypotheses:

- Subjects who have a greater number of eye fixations will have higher scores on the posttest than students who have fewer fixations.
- Subjects who view the stimulus materials composed of shaded line drawings will have more eye fixations than subjects who view either the simple line drawings or the realistic photographic representations.
- Subjects who are in varying categories of intelligence will have different numbers of eye fixations.
- Subjects will score at different levels on the posttest depending on whether they view the simple line drawings, shaded drawings, or realistic photographs.
- Subjects will score at different levels on the posttest depending on

whether they are in the high, middle, or low categories of intelligence.

Method

Subjects. Two groups of approximately 60 members each were identified for the study with one being the control subjects and the other group being designated the treatment group. The control group was composed of freshman and sophomore class members from Mansfield State College and the treatment subjects were all students enrolled at Harford Community College, Bel Air, Maryland which is in close proximity to Aberdeen Proving Ground, Maryland. To reinburse the treatment subjects for their time, each was paid $20.00 for participating in the study and both the treatment and control subjects were paid $0.25 for each correct answer which was above the group mean on the posttest.

Although the treatment subject pool initially contained 64 individuals, there were only 58 subjects available to be included in the treatment group after the viewing segment of the study was completed. The loss of 6 subjects was caused by a variety of problems, i.e., equipment malfunctions. poor subject iris-pupil contrast which prevented accurate tracking by the HEL Oculometer, lack of subject motivation to attend to the projected visuals, subjects who mislead the investigator with regard to their vision and could not distinguish the details in the visuals without their corrective lenses, and excessive body movement by the subject which prevented the oculometer from providing accurate eye movement data. Additional screenings were conducted by the investigator based on the mean number of manual overrides by the oculometer operator to reposition the cursor on the pupil of the subject, the amount of data used by the computer program to determine the number of fixations per slide and the average duration of fixations, and the number of frames which contained highlight error. A total of 46 subjects, whose eye movement data were most valid, (i.e., contained the least amount of highlight error, or fewest manual overrides, etc.), were included in the study.

Apparatus. The HEL Oculometer system comprises a three chamber laboratory; one studio functions as a stimulus viewing room, another as a projection room and a camera room housing optical devices for monitoring eye movement, and finally a room which contains the control and computer systems.

From the viewpoint of the subject, the laboratory is a small room that contains a rear projection screen, measuring approximately 39 inches on a side. The screen is surrounded by soft lighting that provides a moderate amount of light throughout the studio and is sufficient to allow for adequate television monitoring of the eyes. Light from a small unpolarized section of the surround is reflected by the front surface of the cornea and is allowed to pass through the optical system, producing a bright spot (Highlight) at the camera that appears to originate within the eye itself. It is the apparent position of this highlight relative to the center of the pupil that is directly related to eye orientation, or line of sight. The television camera is concealed in what appears to be a speaker box located directly beneath the screen. The subject is seated comfortably in an armchair located approximately 50 inches in front of the screen.

Generally speaking, as long as the subject's head remains within a space of one cubic foot his eye movements will be tracked automatically. Perhaps the most concise description of the more technical camera and control room is that given by Monty (1975). He states that:

> The camera room houses a low light level television camera, a concealed optical relay system, and the eye-tracking system. These systems perform two major functions. The first is merely to relay information to the low light level camera, that is, the image of the eye and highlight go to the image intensifier and camera. The second function, tracking the movement of the eye, is performed automatically by a system of mirrors and lens-focusing mechanisms. These mechanisms keep the eye in focus and within the field of view of the stationary television camera. The control information for servo-motors (sic) that track the eye comes from a processor that determines the location of the highlight and the location of the pupil. The relative position of the highlight and the pupil is used to determine point of gaze. A signal proportional to the position of the pupil is sent to the mirror-servos that continually maintain an image of the eye in the approximate center of the field of view of the camera.
>
> The camera room also doubles as a projection chamber for displaying stimuli to the subject. Virtually any projection device can be used
>
> . . .
>
> The control room houses the electronic processor, experimenter console, data-reduction equipment, and other items. The processor is essen-

> tially a [digital] computer housed in the experimenter's console that computes point of gaze by determining the distance between the center of the pupil and the location of the highlight. This information is displayed on the data panel to the right of the television monitor. It is also recorded in digital form on the videotape recorder to the left of the operator's console. The videotape recorder is particularly important as a backup for the digital computer, which normally processes the data on line. If the computer is shut down for any reason, the experiment can still continue as the data can be stored indefinitely on the videotape for processing at a later time.
>
> The experimenter sits at the console in the control room and views the pupil. He uses the joy stick in front of him to control the movement of a circular cursor on the television screen to "pick up" the target, that is, superimpose the cursor on the image of the pupil. Once the target is acquired, the automatic tracker assumes control and tracks the eye until the pupil is obscured in which case the target must be reacquired manually. Normally, tracking the pupil presents no problem, but the target can be lost if the subject sneezes, laughs violently, rubs his eyes, etc. (p. 333)

Data Collection and Processing

The HEL Oculometer system includes a data collection and processing capability which made the present study feasible. For instance, the information concerning the eye position can be fed into the PDP--11/20 computer from either the electronic processor, if immediate data analysis is required, or from a videotape recorder. It should be noted that the videotape recorder was not used at any point in this study to collect the data.

The computer is interfaced to a 1.2 million word disk and is capable of performing several functions. As Monty (1975) states:

> First, it processes the data in real time so that information such as the pattern of fixations can be provided to the experimenter on the highspeed CRT terminal. . .
>
> Second, it relays the processed raw data to one of the tape decks for storage and subsequent statistical analysis. Thus, it is possible to go directly from calibration of the raw data to anaylsis of group data without manual manipulation of that data. (p. 334)

For instance, a single subject's data are readied for study on a given measure as they are collected and stored on the magnetic tape until all subjects have been tested. The information is then pooled automatically in whatever fashion desired and subjected to analysis. It is interesting to note that over one million frames of data can be reduced for statistical analysis on a given criterion in less than four hours.

Statistical design. The experimental design which was utilized in the study was basically the posttest-only control group. It was not possible to assign the subjects randomly to either the control or treatment group because the individuals were from different geographical areas. It is believed, however, that the groups were equivalent with regard to knowledge about the heart because a general physiology screening test was administered to each group and no significant difference in knowledge was found.

Otis-Lennon Mental Ability Test. Only the raw scores which the subjects attained on the Otis-Lennon test were used for comparison purposes in the present study. Specifically, the raw score was utilized to subdivide the treatment group into one of three categories of intelligence, i.e., high, middle, and low by computing the mean and standard deviations of the raw scores.

Stimulus material criterion tests. The investigator utilized the criterion tests developed by Dwyer (1972, 1975) to measure the amount of learning which the subjects attained by viewing the stimulus materials. A general physiology pretest of 36 items was administered initially to the subjects to establish a baseline for their general knowledge of human anatomy. After the subject had viewed the slide tape presentation he/she was then asked to complete the 78-item posttest.

Stimulus materials. The stimulus materials used in this study consisted of a sequence of 39 slides and a synchronized 18 minute, 30 second audiotape which were developed by Dwyer (1975), and it is of special importance that he created different sets of materials which employ visuals of varying sophistication, i.e., simple line drawings, shaded line drawings, and realistic photographs. The visuals have been thoroughly tested and it has been determined that they have the same capability of teaching the subject content.

Procedures. The treatment subjects were administered the physiology pretest and the mental ability test before they were individually shown the stimulus slides in the HEL Oculometer viewing room. Then each subject was individually taken to the viewing chamber and he/she was asked to watch a variety of slides and to complete a number of visual search tasks. The tasks as exposed to the subject were: (a) location of various military vehicles which were camouflaged to varying levels of sophistication. This was a bogus task and was used only as a means of helping the subject become accustomed to his surroundings, (b) identification of Landolt's circles. During this sequence, four slides were shown to the subject and he/she was questioned about each. This calibration exercise which is done under the guise of focusing the projector was completed in 2 minutes, 30 seconds, and (c) the viewing of one of the three randomly assigned possible presentations on the heart. The time for this last task was 18 minutes, 30 seconds and contained 39 slides. When the subject had completed viewing these materials, he/she was taken to another room and was administered the posttest.

The control subjects were administered the physiology pretest and the mental ability test by the investigator during the week immediately preceeding the time of the study at HEL, APG. The posttest was administered to these same individuals during the week immediately after the completion of the study. In each testing situation, the instruments were administered during the subjects regularly scheduled class period.

Presentation and Analysis of the Data

The t test was used to measure for any significant difference in the knowledge of basic anatomy of the subjects as determined by the physiology

Table 1

The Mean and Standard Deviation Scores for the Average Number of Eye Fixations for the Complete Treatment of 39 Slides

		Treatments					
IQ Level		Simple Line		Shaded Line		Realistic Photographs	
		$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD
		n = 10		n = 6		n = 2	
High	Fix.	34.53	10.93	45.48	13.88	42.25	2.85
		n = 2		n = 7		n = 5	
Middle	Fix.	32.16	14.51	29.41	7.14	41.06	5.83
		n = 4		n = 6		n = 4	
Low	Fix.	24.57	7.59	30.48	11.73	33.18	16.21

examination between the treatment group and the control group. The results of the test indicated that there is no significant difference in the scores since the t value is 1.64 (89), p, .104.

The t test was also used to test for any significance between the treatment group and the control subjects with regard to posttest scores. The results of the statistical tool in this situation reflected a significant difference between the scores since the mean score for the control group is 18.84 and a score of 41.89 for the treatment subjects, t (68) = -12.7, p = .001.

The eye movement indice which was examined in this study to determine if there is a relationship between it and the posttest score was the average number of eye fixations per treatment or the average number of eye fixations of selected segments of the treatment.

The mean ($\bar{X}$) and standard deviation (SD) for the average number of eye fixations for the complete 39-slide sequence is presented in Table 1. The data is reported for each cell, i.e., by the intelligence level of the subject and type of drawings viewed. Table 2 reflects the average number of fixations reported in a similar format except that in this latter situation the mean number of fixations is presented for each group of 13 slides, which composed the complete sequence of 39 slides.

Insert Tables 1 and 2 about here

To test for any relationship between eye fixation and posttest scores,

Table 2

The Mean and Standard Deviation Scores for the Average Number of Eye Fixations for the Three Groups of Slides

		Treatments					
IQ Level		Simple Line		Shaded Line		Realistic Photographs	
		$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD
		n = 10		n = 6		n = 2	
High	First	42.36	15.45	58.07	11.34	57.42	4.62
	Second	30.46	11.03	40.38	14.61	37.27	1.47
	Third	30.44	9.63	37.36	16.85	40.71	2.42
		n = 2		n = 7		n = 5	
Middle	First	45.85	7.96	36.59	9.58	48.48	6.55
	Second	22.65	11.59	26.77	8.26	41.82	6.64
	Third	27.63	25.87	24.50	9.43	32.20	9.06
		n = 4		n = 6		n = 4	
Low	First	30.75	14.33	43.40	17.05	40.54	13.24
	Second	22.88	5.14	24.24	8.44	30.00	17.05
	Third	22.85	4.57	23.25	13.92	28.65	18.87

the Product Moment Coefficient of Correlation was utilized. The overall relationship between eye fixations and posttest score is r = .2467, p = .049. Three additional Pearson r's were computed for each group of 13 slides since it was anticipated that viewer fatigue, degree of attentiveness and how quickly the subject learned to adapt to the instruction would cause the number of fixations of the subject to vary throughout the viewing of the slide program. The relationship between the average number of fixations for each group of slides of the complete program and the posttest score (in terms of correlation coefficient) are .1834, p = .111; .1948, p = .097; and .3040, p = .020 respectively.

To determine if eye fixations are influenced by either the type of visuals viewed or the intelligence of the viewer, two-way analysis of variance was employed. The effect of the type of treatment is not significant, F(2, 57) = 1.73, p = .192, but the intelligence level of the subject did influence the average number of fixations and is significant, F(2, 37) = 3.89, p = .029.

To determine which levels of intelligence created the significant results in the two-way analysis of variance, a follow-up test was conducted utilizing the procedure for unequal n's (Winer, 1971). After the a priori tests were completed, it was found that the significant difference in the number of fixations is between the subjects in the high and low categories of intelligence.

It has been previously mentioned that the number of eye fixations would most likely fluctuate throughout the viewing of the slide program for a variety of aforementioned reasons. To overcome this problem which could skew the data, two-way analysis of variance with repeated measures was utilized. In this case the treatment type is not significant, $F(2, 37) = 1.73$, $p = .191$. However, the effects of intelligence level are significant, $F(2, 37) = 3.88$, $p = .030$. In addition, the mean number of fixations did vary throughout the treatment, $F(2, 74) = 58.74$, $p = .001$, but neither the interaction of treatment type and slide group, $F(4, 74) = .68$, $p = .610$ or intelligence level and slide group $F(4, 74) = .41$, $p = .799$ are significant using the repeated measures test.

Finally, two-way analysis of variance test was used to determine if there was a relationship between the total posttest mean score and: (a) the intelligence level of the subject, and (b) the type of visuals viewed. The effect of the type of visuals viewed is not significant in relation to posttest scores with $F(2, 37) = .52$, $p = .599$. The intelligence level of the subject, however, is significant with $F(2, 37) = 7.33$, $p = .002$.

Conclusions

The present study supported previously reported findings that there is a relationship between the number of eye fixations and internal cognitive activity. In addition, the data suggested that there was a novelty factor occuring when the subject first began to view the visuals because most of the subjects had the highest number of fixations in the first sequence of 13 slides regardless of the type of visuals viewed. The average number of fixations then decreased over the treatment and the last sequence of 13 slides had the lowest number of fixations, but the highest correlation with the scores on the posttest.

The question of picture complexity and the influence of intelligence level of the viewer has mixed results when the present findings are compared with earlier research. It has been previously summarized that the more complex visuals are fixated more frequently, but if the stimulus materials are too complex, the subject will fixate centrally. The results of the present study did not confirm these previously published reports since there was no significant difference in the number of eye fixations across the treatment types.

However, the present study supported previously reported research in that there is a correlation between intelligence and eye movement indices. It should be emphasized that the significant relationship which was found in the present study pertained only to the highest and lowest categories of intelligence with the more intelligent subjects having significantly more fixations than the less intelligent subjects.

The final question of the present investigation studied the influence of the type of visuals viewed and the intelligence of the viewer on the posttest scores. Previous research conducted by Dwyer (1975) has indicated that simple line drawings produce the most efficient learning when instruction is presented at a fixed pace. The present study could not confirm these previously published findings because the type of drawings viewed was not significant even though the pace of instruction was fixed. Intelligence, however, was significant with the most intelligent subjects gaining the most on the posttest.

Discussion

In the present study the writer was most interested in the relationship of posttest scores and the number of fixations. Past research has indicated that there is a positive correlation between learning and the number of eye fixations. The present study confirmed this relationship utilizing an unobtrusive eye movement measuring system.

It should be noted that there was an overall significant relationship between the number of fixations and the posttest score due principally to the last group of 13 slides. As stated earlier, the groups of 13 slides were an artificial breakdown for statistical purposes because the slide program was continuous with no logical subdivisions. It is believed that initially the subject made many extra fixations to establish the general gist of the visuals during the viewing of the first two groups of slides. Then as the subject adapted to the visuals, he/she realized that the slides primarily differed only in detail and reduced his/her fixations to the key areas of interest which were emphasized on the audiotape. Consequently, there is a stronger correlation between the fixations and posttest scores for the last group of slides. These results are consistent with other studies (Loftus, 1976; Potter, 1972 cited in Loftus, 1976) because in both of these studies, the subject had the fewest fixations toward the end of their learning task.

The second objective of the study was to determine if eye movements are stimulus or person specific. The present study did provide evidence that they are person specific because the subjects in the highest category of intelligence had a significantly higher number of fixations than the subjects in the lowest category of intelligence. This finding supports previously reported research.

The investigator did not find any relationship between the type of visuals viewed and eye movements. This result is similar to Baron's (1979) work. Although she was primarily concerned with the relationship between the attending behavior of children and the variable of motion in the stimulus materials and the present investigator was analyzing the relationship between visuals of varying detail and learning, neither study found any evidence that the stimulus materials influenced eye movements. It should be noted, however, that the findings of the present study were both internally consistent and supported the research of Loftus (1972, 1976), i.e., no difference in eye movements should be expected because there was no significant difference in the posttest scores.

The investigator would caution against drawing any definite conclusions from the present study with regard to the issue of stimulus materials and their influence on eye movement because of a procedural difficulty. It was noted earlier that a total of 64 subjects participated in the study, but only 58 subjects completed the entire cycle. From this latter group, 20 subjects viewed the simple line drawings, 19 subjects were exposed to the shaded line treatment, and 19 individuals watched the treatment composed of realistic photographs. The interesting point is that of the 58 subjects who completed the treatment, only the data from 46 subjects were used for the study. The composition of the treatment groups was: (a) 16 subjects viewed the simple line drawings, (b) 19 subjects viewed the shaded line drawings, and (c) 11 subjects viewed the realistic photographic treatment. In other words, it was more difficult to identify subjects who had valid eye movement data in the simple line drawings and, particularly, in the realistic photograph treatment. Consequently, it is possible that the investigator did not have a representative sample of eye movement data in comparing the three types of visuals.

Finally, the investigator questions the results which occurred concerning the posttest scores and the type of visuals watched. Previous research (Dwyer 1972, 1975) reported that when subjects were exposed to the visuals in a fixed pace format, the simple line drawings promoted the highest posttest scores. In the present study, however, no significant difference was found between the treatment types. This finding also held true when the test scores of the original subject pool, i.e., 58 subjects, was analyzed.

In conclusion, the results of this study are offered in an attempt to determine if the number of eye fixations are an external indicator of internal cognitive processes. Succinctly, this study supported previous investigations. The writer believes that this is particularly important because an unobtrusive eye movement monitoring device was utilized to collect the data which permitted a naturalistic viewing situation.

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COMMUNITY COLLEGE STUDY OF MEDIA UTILIZATION AND INSTRUCTIONAL METHODOLOGIES USED IN SCIENCE COURSES & RELATED AREAS: A NATIONAL STUDY

by

Jacqulinn F. Oxford
Program Development Specialist
Technical Training Center
Duke Power Company
Cornelius, N.C. 28031

and

David M. Moore
Associate Professor
Virginia Tech
Blacksburg, Virginia 24061

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It has long been held that the primary function of a community college instructor is teaching. The notion pervails that because teaching is an important community college function, faculty may be more progressive and innovative in their instructional approach than the faculty in four year colleges and universities. The data collected by Arthur Cohen in a nationwide study concerning the role of the sciences and technologies in two-year colleges afforded an opportunity to examine the instructional and technological methodologies used in these institutions.

The purpose of this study was to explore the instructional methodologies and media utilization in science or science related courses in community colleges across the United States and to determine if these instructors are as innovative as has been perceived in some quarters.

The data used for this study were originally collected by Cohen (1978) in a nationwide study of science and science related courses in two-year colleges. Cohen's study was designed to obtain information aobut the curriculum, instructional practices and course practices of these courses. These data were collected from the responses to an Instructor Survey, mailed to 1275 faculty members teaching science or science related courses from a sample of 175 community colleges. This study was conducted by the Center of the Study of Community Colleges under a grant from the National Science Foundation. The teaching methods and approachs were ascertained from a random one-thirteenth of science instructors in the 175 sample community colleges. (Brawer and Friedlander, 1979).

The data were examined from several perspectives. First, item seven on the questionnaire dealing with percentage of class time in an entire term devoted to a particular instructional methodology, was reviewed. Course/ sections where lecture was greater than 50% or less than 50% were identified.

Percentages from two other portions of this item: viewing and/or listening to film or taped media, and simulation/gaming were combined to form a category of media utilization. Simulation/gaming were added because in many circles these are defined as "media" using this data, two major groups were formed, course/sections where class time over the entire term was devoted to 50% or more lecture and 25% or less media (Group LM, N = 616), and those where lecture was less than 50% and media were used more than 25 (Group MM, N = 41). This grouping comprised 51.5% (N = 657) of the 1275 courses represented in the survey. It must also be noted that a small number of course/sections may be contained in both groups because of the percentage break points.

Groups LM and MM were further examined to ascertain and compare (1) Media utilization and attrition, (2) Media production facilities/assistance available and media production facilities/assistance utalized, (3) Media usage and (4) Self media developers.

The data from part eight of the survey (frequency of media used and self developed) were examined from three prospectives. First, the frequent and/or occasional use of media was reviewed in sections where lecture was used less than 50% of the time. Secondly, an attempt was made to identify self media developers (developed by self or other faculty members) by geographic region. Proof of media development was determined by one or more checks in the column labeled developed by self or other faculty member. A third comparison was made between the self media developer, availability and whether or not the instructor felt availability of more media or instructional materials would improve the course.

MEDIA UTILIZATION AND ATTRITION

Many believe that the use of media or instructional technology in the classroom will improve instruction and facilitate learning. There is;

however, little "hard" data to support this theory. Research on the use and effectiveness of media to teach adults is very sparse and according to Campeau (1974) the quality of the experimental designs is marginal in many of these studies. For the most part no significant difference was found between the traditional lecture method of instruction and media used singly or in combination. Moldstad (1974) identifies several studies which supports the notion that students prefer multimedia and/or audio-tutorial instructional programs to traditional instruction. But, it must be noted that much of the research reviewed by Moldstad was conducted either in elementary or secondary schools. Advocates of instructional media; however, still preach that the use of different modes of instructional technology enable learners with diverse backgrounds, differing entry levels and learning types to achieve success. There is no question that community colleges have more than their fair share of non-traditional students. Since students seem to prefer instruction integrated with media, their use in a curriculum may serve as a much needed stimuli to motivate and retain this type of student.

When Groups LM and MM (as defined earlier) were compared, it was found that Group MM had a larger percentage of sections with a completion rate of 90-100. In this category the female course completion rate was 54% and the male course completion rate was 37% as compared with 41% for females and 32% for males in Group LM. See Table 1. This seems to indicate that media may have a retention effect where the attrition rate is 10% or less. Further, females may be more receptive then males to instruction integrated with media, although Clowes (1980) indicates that females complete at a higher rate than males generally.

Insert Table 1 about here

This characteristic did not hold true across all categories, however. When the percentages should have been decreasing as the attrition rate increased, the percentages in the completion rate category of 70-79 for Group MM, male and females, were higher than Group LM. Group MM, males also showed a higher percentage of course sections in completion rate category 60-69 then Group LM. See Table 1. Apparently media utilization had little if any effect on these sections.

Completion rates of course/sections in Group MM were also compared with the curricular functions of course/sections i.e., transfer, general education, preparation for work, and remediation, identified by Clowes, (1980). In the completion rate category of 90-100 the percentage for Group MM, male and female course/sections were higher than transfer, general education and remediation. The male and female course completion rate for the curricular function preparation for work is slightly higher than for Group MM. This higher percentage may be due to the identified curricular function of the courses rather than the instructional methology applied. In Group MM the percentage of male and female sections with a completion rate of 70-79 and male sections with a completion rate of 60-69 is slightly higher than the sections in the curricular functions with the same sompletion rate. Similar differences existed between Group LM and MM. Once again, the use of media seems not to have decreased the attrition rate.

Only 41 sections out of 1275 were identified for Group MM (less lecture, more media). Other than the fact that media were used 25% or more of the time, there were no way of determining whether the media met the objectives of the course or whether the instructors even used them properly. Both these criteria would determine the effectiveness of the media. Brawer and Friedlander (1979), using the same data set, discovered that films, overhead transparencies, maps, charts, illustrations and displays were used either frequently or occasionally by half of the respondents. But, apparently media are being used to supplement other instructional approaches rather than becoming a primary instructional methodology.

MEDIA PRODUCTION FACILITIES/ASSISTANCE AVAILABLE AND MEDIA PRODUCTION FACILITIES/ASSISTANCE-UTILIZED

It was thought that the make-up of Group LM and MM might be contingent upon media production facilities/assistance available to the instructors. A regional review of this variable indicated a slightly higher percentage of availability for Group MM in all but one region, the mid-west. Table 2 shows the breakdown of this variable by group and region. One of the primary differences observed with this comparison was that instructors in Group LM who had production facilities/assistance available seemed to take less advantage of that service than the instructors in Group MM. Since the largest percentage of sections for Group MM had fallen into the Southern and Western regions, it was not surprising to note that these regions also showed the largest percentage of media production facilities/assistance. It was also interesting to find that at least a third of the media users (Group MM) in the South and West had no media production facilities available to them. For those who did have media facilities available, only 70% in the South and 63% in the West actually utilized the facility. This apparently means that at least a portion of the media utilized are being purchased or developed independently by the instructor.

Insert Table 2 about here

Two factors may be responsible for the distribution of Groups LM and MM across regions. First, the largest number of sections for both groups appear in the South and West. This may relate to the large number of community colleges in these regions. A second factor may be eligibility for grants for developing institutions. It may be speculated that in many of the institutions in the South and West would qualify for money that could be used for faculty development, expansion of experimental programs, and the purchase of equipment and materials for instructional purposes. Whatever the reason, these two regions clearly stand out. When course/sections in Groups LM and MM are compared across regions, the percentage distribution for Group MM is about the same or slightly higher than Group LM in all but one region. In the Midwestern region, the percentage of course/sections in Group LM is 24% as compared to 12% in Group MM. With this one exception, region does not seem to make a difference in media utilization (See Table 2).

When Groups LM and MM were compared by geographic regions, it was found that the South had the largest percentage from both Groups with the West ranking second highest for both groups. Group LM had 30% and Group MM had 37% of their sections in the South. In the West Group LM showed 26% and Group MM 29%. Region did not make much difference in media utilization; table 2 shows the percentage distribution of Groups LM and MM by region to be almost the same.

MEDIA USAGE

As mentioned earlier, Brawer and Friedlander (1979) had already discovered that the media most frequently or occasionally used in the total survey were films, transparencies, and maps, charts illustrations, displays. Table 3 indicates at least 50 percent use of these same media in sections where less than 50% of class time was spent lecturing. Scientific instruments were the most frequently used medium.

Insert Table 3 about here

This is understandable since many of the sections would require these instruments for class and laboratory demonstrations. The medium that has the least utilization in this NSF Survey was broadcast/cable television. This is probably due to a lack of programming to meet the needs of this population. If a comparision were made between this survey and Cohen's humanities survey, (1975) the percentage of utilization would probably be higher for the humanities. Public television in particular seems to slant programming toward the humanities.

In almost every instance the percentage for a medium is higher in the occasionally used category than for frequently used. Scientific instruments and preserved or living specimans were the only exceptions. If you add the percentages of these two categories, the figure looks rather impressive. This figure; however, does not supply any hard data to substantiate the full extent of media use in the community college. When compared with the number of sections identified in Group MM, sections that used media over 25% of the time, it seems to be apparent that frequently or occasionally may mean that instructional media are supplemental tools for more traditional instructional approaches.

SELF MEDIA DEVELOPERS BY GEOGRAPHIC REGION

Brawer and Friedlander (1979) explored the incidence of media development and recorded the number of times a check was placed in the "developed by self or other faculty" column for each medium. An attempt was made to ascertain whether media development was associated with specific geographic regions. As Table 4 indicates the South and West are represented most heavily although this may reflect the larger number of sections in these regions rather than more enthusiasm for media development.

When the percentages rather than actual numbers are compared, the Northeast had the highest percentage (41%) of media developed. There appears, however, to be little variation in the percentages.

Insert Table 4 about here

All sections that used at least one or more media developed by an instructor were compared by size of institution and geographic region. Institutions with a student population of 2500 to 4999 had the largest percentage representation of media developers from the Northeast, South, and Mountain regions. The largest percentage of media developers from the Middle States were found in institutions 5000 to 7000 in size; from the Midwest media developers were concentrated in institutions of 10,000 to 14,999 and in the West in institutions with populations over 15,000.

At least a third of these media developers did not take advantage of the media assistance available to them. When the respondents were asked if availability of more media or instructional materials would have made a better course, 32 percent of those without media facilities/assistance checked that response. This same response was also checked by 42 percent of those who had media facilities/assistance available to them. These reactions seem to strengthen the earlier theory that media use can improve the course and what is actually taking place are two different things. The data collected seem to indicate occasional rather then frequent use of media in science and social science courses in the two year college.

SUMMARY

The results of this study reveal that the instructional methodology used in the largest number of course/sections in community college science and science related curricula is the lecture. Media are not used extensively and seem to have little, if any effect, on reducing the attrition rate of males and females. Geographic region seems not to effect media utilization. From the responses given regarding frequency of media use instructional media are apparently viewed as supplemental tools rather than as instructional methodology. There is some involvement in media development, but geographic region seems not to be an influence. The availability of media facilities/assistance did not seem to be a determiner of media development since these facilities were often not used. A comparison between this NSF Study and Cohen's earlier Study of the Humanities (1975) is needed to determine whether these findings can be generalized as characteristics of the majority of course/sections in community colleges.

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Table 1

The Frequency of Sections of Courses Completed by Males and Females and Instructional Methodology

	GROUP LM Lecture 50 + % Media - %		GROUP MM Lecture 50 - % Media + %	
Completion Rate	M	F	M	F
90-100	199 (32)	251 (41)	15 (37)	22 (54)
80-89	140 (23)	128 (21)	8 (20)	3 (7)
70-79	102 (17)	81 (13)	8 (20)	10 (24)
60-69	73 (12)	72 (12)	9 (22)	3 (7)
50-59	51 (8)	36 (6)	1 (2)	1 (2)
49 7	49 (8)	47 (8)		2 (5)
	616	616	41	41

(Percentages in Parenthesis)*

*Percentages have been rounded off and may not equal 100.

Table 2

REGIONAL DISTRIBUTIONS OF GROUP LM AND MM BY MEDIA PRODUCTION FACILITIES/ASSISTANCE AVAILABLE AND MEDIA/FACILITIES ASSISTANCE UTILIZED

	Group LM Lecture 50% or more Use Media less than 25% (N=616)						Group MM Lecture less than 50% Use Media more than 25% (N=41)					
	Total Pop.		Media Ass't Available		Media Ass't Used		Total Pop.		Media Ass't Available		Media Ass't Used	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Northeast	17	2.8	10	1.6	6	1.0	1	2.4	1	2.4	1	2.4
Middle States	76	12.3	57	9.3	32	5.2	5	12.2	5	12.2	5	12.2
Southern	182	29.5	110	17.9	64	10.4	15	36.6	10	24.4	7	17.1
Midwestern	145	23.5	103	16.7	60	9.7	5	12.2	2	4.9	2	4.9
Mountain	35	5.7	20	3.2	12	1.9	3	7.3	2	4.9	2	4.9
Western	161	26.1	88	14.3	44	7.1	12	29.3	8	19.5	5	12.2
Column Total	616	100.0	388	63.0	218	35.4	41	100.0	28	68.3	22	53.7

Table 3

Frequent and Occasional Use of Media in Sections Where Less than 50% of Class Time Spent Lecturing

Media	Frequently Used	Occasionally Used	Total Percent
Film	73 (11)	275 (42)	53
Filmloops	10 (2)	103 (16)	18
Filmstrips	28 (4)	110 (17)	21
Slides	61 (9)	176 (27)	36
Audiotape/Slide/ Film Comb.	25 (4)	124 (19)	23
Transparencies	149 (23)	180 (28)	51
Audiotapes, cassettes, records	32 (5)	119 (18)	23
Videotapes	24 (4)	134 (21)	25
TV Broadcast	7 (1)	46 (7)	8
Maps, Charts, Ills., Displays	147 (23)	242 (37)	60
3-D Models	88 (14)	206 (32)	46
Scientific Inst.	168 (26)	159 (24)	50
Specimens	84 (13)	53 (8)	21
Experiments	98 (15)	133 (20)	35
Other	47 (7)	17 (3)	10

(Percentages are in Parenthesis)*

*Percentages have been rounded and may not equal 100.

Table 4

Number of Media Developers in the Media Survey by Geographic Region

Geographic Region	Zero to 1 medium	1 to 2 media	More than 2 media	Row Total
Northeast	23 (59)	0	16 (41)	39
Middle States	111 (66)	9 (5)	48 (29)	168
Southern	246 (70)	9 (3)	97 (28)	352
Midwestern	196 (69)	22 (8)	67 (24)	285
Mountain	48 (65)	2 (3)	24 (32)	74
Western	218 (61)	26 (7)	113 (32)	357

(Percentages are in Parenthesis)*

*Percentages have been rounded and may not equal 100.

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A RELATIONSHIP BETWEEN BRAIN HEMISPHERICITY AND PSYCHO-EPISTEMOLOGY

Richard Rancourt, Ph.D
Jean-Paul Dionne, Ph.D.
Faculty of Education
University of Ottawa
651 Comberland Land
Ottawa, Ontario
CANADA
KIN 6N5

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ABSTRACT

During the last three decades, research has been carried on in two distinct areas that potentially may help identify an as yet unknown molar trait and, at the same time, offer an explanation for the divergence of ideas, models and theories about the teaching-learning process. Brain research and psycho-epistemology have both raised a question regarding the assumptions of (1) logical equivalence of subject matter and (2) logical equivalence of the modalities of knowing.

A brief overview of psycho-epistemology and particularly the concept of hemisphericity is presented. A parallel between both areas of research is drawn. The suggestion that the Psycho-Epistemic Profile Inventory can be used to assess hemispheric dominance is advanced. Empirical data relating hemispheric (epistemic) dominance to student learning in individualized instruction are presented. Similarly, empirical evidence is furnished to indicate that there exists a relationship between hemispheric (epistemic) dominance in teachers, on the one hand, and their field of specialization and their preferred teaching subject matter on the other.

Theoretical and practical implications are noted and directions for further research are presented.

INTRODUCTION

The purpose of this paper is to indicate a possible link between two distinct areas of research which may potentially help to identify an as yet unknown molar trait which could be responsible for divergent opinions regarding teaching and learning theories and may help to explain differential achievement when these theories are empirically investigated. Research in psycho-epistemology and hemispheric dominance will be examined and a theoretical parallel will be established. The suggestion that an instrument known as the Psycho-Epistemic Style Inventory can be used to assess hemispheric dominance will be advanced. Some empirical evidence will be furnished to indicate that there exists a relationship between hemispheric (epistemic) dominance in teachers and learners, on the one hand, and their field of specialization and/or their preferred subject matter on the other. The theoretical and practical implications are noted and directions for further research are presented.

PSYCHO-EPISTEMIC STYLES

Briefly stated, both philosophical and psychological epistemology are concerned with a concept variously labelled as "knowing", "thinking", or "modalities of inference". Authors such as Scheffler (1965, p. 1-6); Morris and Pai (1976, p. 102-265); Pai (1973) and Wirsing (1972), suggested that there may be epistemological relationships among the learner, the teacher, the teaching strategy and the curricular content. Although terminology may vary from author to author, most are in general agreement that there are possibly three basic modalities of "knowing".

An inductive process of knowing is generally regarded as analytic (inductive) thinking or empirical thinking (Bruner, 1960, p. 57-58); (Morris and Pai, 1976, p. 161-165); a deductive process of knowing is considered as logical or rational thinking (Morris & Pai, 1976, p. 179-180); (Wirsing 1972, p. 49-54); and a creative or analogical process of knowing is referred to as intuitive or metaphorical thinking Bunge (1962, p. 78-79); Scheffler (1967, p. 16-19); Bruner (1960, p. 58); Samples (1976). These definitions do not represent unanimaty of opinion, but a general agreement about the existence of these three broadly defined modalities of "knowing". Bruner (1960, p. 50-68) has attempted to demonstrate theoretically that there may well be a strong relationship between modalities of knowing, on the one hand, and the structure of disciplines and the teaching-learning process on the other. Vernon (1962, p. 302) and Sutter and Reid (1969, p. 153-157) noted that there may be incompatibility between inflexible, structured, sequential teaching strategies and learners who are characterized as "intuitive", "creative", "analogical" thinkers. Similarly, McClellan (1962, p. 107), analyzing the structure of disciplines, wrote "How is knowing in mathematics different from knowing in science and in poetry? It appeared that up until recently, the search for a "best" theory of teaching, a "best" theory of learning and a "best" philosophy of education assumed the logical equivalence of knowledge from the various disciplines.

Royce's Multi-Factor Theory of Individuality

During the early 1950's, work was begun on a model which was formalized in 1964 with the publication of a book entitled The Encapsulated Man. Since then, the model has been incorporated within a larger theoretical framework called Multi-Factor Theory of Individuality (1971). This metatheoretical model, using both the theory and the methodology of factor analysis, attempts, according to the author, to "accommodate all psychological differences, such as reaction time and conditionability to molar differences such as values and world views" (Royce, 1973, p. 3).

Thus Royce's Multi-Factor Theory of Individuality postulates that the total psychological system is a "multi-dimensional, organized system of processes by means of which an organism produced mental and behavioral phenomena" (Royce, 1977, p. 2).

This elaborate supra-system subsumes six major systems, namely: sensory, motor, cognitive, affective, evaluative, and style.

Each system is defined by Royce (1976, p. 6-7) as follows:

1. The cognitive system is a multi-dimensional, organized system of processes by means of which an organism produces cognitions.

2. The sensory system is a multi-dimensional, organized system of processes by means of which an organism produces sensations.

3. The affective system is a multi-dimensional, organized system of processes by means of which an organism produces affective phenomena.

4. The style system is a multi-dimensional, organized system of processes by means of which an organism manifests cognitive or/and affective phenomena.

5. The evaluative system is a multi-dimensional, organized system of processes by means of which an organism manifests normative phenomena.

6. The motor system is a multi-dimensional, organized system of processes by means of which an organism produces outputs.

The system described by Royce is multi-dimensional, interactional, and hierarchical. Within each of the systems is subsumed a total of 150 traits which have been factorially identified (Powell, Royce, 1977, p. 2). What is to be noted in this hierarchy is that which Royce calls higher-order personality integrators. The closer a trait or a group of traits is to the apex of a system, the greater its influence on the system, and the greater its role as a personality integrator (Royce, Buss, 1976, p. 8). Similarly, the closer a system is to the supra-system, the greater its influence on personality.

Of particular interest to this study is the style system. This system, considered to be near the apex of the supra-system, is therefore as Royce suggests, an integrative information-processing system (Royce, 1971, p. 330).

Royce suggested that attempts at communication between specialists had, for the most part failed because of insufficient overlapping of reality perspectives. Such absence of overlapping is due, according to Royce, to differences in either implicit or explicit epistemological commitments. Empirically-oriented scientists rely mainly on facts derived from observations; mathematicians rely on logical consistency; poets convey meaning through metaphors.

More specifically, for Royce, "encapsulation" is defined as looking at life partially, but issuing statements concerning the wholeness of living; it means claiming to have the whole truth when one has only part of it (Royce, 1964, p. 30).

According to Royce there are three main types of encapsulation; rational, empirical and metaphorical. These three types of encapsulation help explain (Royce, 1974, p. 151) that knowing in the arts, for example, is not the same as knowing in the sciences. How might they differ?

They might differ both psychologically and philosophically. On the philosophic side there may be different truth criteria. Does it make sense, for example, to demand empirical repeatability in evaluating truth claims in literature? And psychologically one might expect differential involvement of the cognitive processes. Symbolizing, for example, may be more crucial, or be of a different order, in the creation of artistic products, than in the creation of mathematical or logical-deductive systems.

A conceptual inquiry (Royce, 1970; Royce, Rozeboom, 1972) into epistemology, and a subsequent analysis of the empirical research (Royce *et al*, 1975; Royce, Smith, 1964; Smith et al, 1967), led Royce to the following description of each of the ways of knowing:

1. *Metaphorism*: The person whose view of reality is largely determined by his commitment to metaphoric experience would test the validity of his view in terms of the universality of his insight or awareness. The cognitive processes underlying this commitment are of a symbolizing nature, including both conscious and unconscious aspects.

2. *Rationalism*: The person whose view of reality is largely determined by his commitment to rationality would test the validity of his view of reality by its logical consistency. The major underlying cognitive processes involve clear thinking, and the rational analysis and synthesis of ideas.

3. *Empiricism*: The person whose view of reality is largely determined by his commitment to external experience would test his view of reality in terms of the reliability and validity of observations. The major underlying cognitive processes involve active perception and the seeking out of sensory experience.

These different ways of knowing are combined by individuals in different preference orders. It is these epistemic hierarchies, along with their subsumed traits, that account at least partially for differences in Weltanschaüung. The three epistemic styles lead, necessarily, to the various disciplines of knowledge. The scientist, for example, may "think", "symbolize" and "perceive" as a scientist, but will, concomittantly maximize the rational and empirical ways of knowing and minimize metaphoric symbolizing in making a final judgement. It is as Skinner (1957, p. 428) wrote: "the role of science is to replace the metaphor". Conversely, the artist, who also evokes his entire cognitive repertoire, may maximize the symbolizing process at the expense of the thinking and perceptual processes. Although academic specialization tends to lead to a dominant epistemic profile, none of these epistemic styles operates independently of the others; that is, "one does not think independently of sensory inputs and the process of symbol formation, nor do we perceive independently of thinking" (Royce, 1973, p. 13).

The theoretical analysis, to this point, leads to the description of an instrument which Royce developed to assess epistemic styles in individuals.

The Psycho-Epistemic Profile (PEP)

The development of PEP began in 1961; to date there have been six revisions. The latest form (Form VI) contains 90 randomly ordered items, 30 items for each of the three dimensions. For each item the respondent is to indicate on a five-point scale, agreement or disagreement with a proposed statement.

To study the validity of the PEP, Royce examined the responses of groups whose characteristics were known. Smith et al (1967) confirmed that empiricism is the dominant epistemic characteristic among those professional individuals engaged in biology; that metaphorism is dominant among those engaged in performing arts; and that rationalism is dominant among those engaged in mathematics and theoretical physics. Additional evidence for the validity of the PEP was reported by Royce (1975); Kearsley (1975); Mos et al (1975); Zelhart and Wargo (1971); Coan (1973); and Schopflocher and Royce (1980) provided considerable support for the theoretical assumptions underlying the construct of epistemic styles and the three dimensions as measured by the PEP. The test-retest reliability of the PEP has been assessed in a few studies; the resulting coefficients ranged from 0.61 to 0.87 for the individual scales and for intervals of 3 and 9 months (Royce et al, 1975).

Concurrent validity of the PEP was substantiated by comparison with other tests. Mos et al (1975) found significant correlations between PEP and each of the following: the Allport-Vernon-Lindzey Study of Values, the Myers-Briggs Type Indicator, and the Edwards Social Desirability Scale.

Taken as a whole, the above mentioned studies provide sufficient evidnece that PEP is a reliable and valid measure of an individual's epistemic style.

HEMISPHERIC DOMINANCE

It has not always been obvious that the brain is the center of thought, memory, or emotion. In the ancient world, including the great civilisations of Egypt and Mesopotamia, thought and emotion were attributed to other organs like the stomach, the liver, etc. Aristotle felt the brain served to cool the blood in the heart. For fifteen hundred years progress was hampered by the feeling that to examine the brain was to violate the seat of the soul. In the eighteenth century it became apparent that some special functions were localized; whenever certain areas of the brain were damaged a loss of specific functions could result. Out of this idea grew the science of phrenology, which held that it is possible to assess an individual's mental abilities by studying the skull. By the twentieth century it became apparent that such a neat localization of mental abilities was not possible. Over the last thirty years knowledge of the human brain has grown at a fantastic rate. "The human brain has become the most challenging frontier of science..." Russell (1979, p. 18).

The brain perceives, remembers, monitors and interprets a myriad of different functions every second of every day of our lives. It processes information extremely fast. For instance, within a fraction of a second it can perceive a person's face, analyse it in many details, synthesize all the information into a single whole, create a conscious three-dimensional full-color experience of the face, recognize this face out of thousands of others recorded in memory and recall details, ideas, associations and images connected with the person. Yet, at the same time, it monitors body functions, initiates expressions, etc. Russell (1979) adds that unlike a computer "the brain not only works in linear step-by-step fashion, but also performs parallel processing, integrating and synthesizing information, and abstracting from its generalities".

For most humans, the whole brain is divided into a left and right half joined by a massive bundle of nerves, called the corpus callosum, containing some 200 million fibers. Each half seems to have developed specialized functions, the left side appearing better at some tasks and the right side better at others. The impact of this hemispheric dominance has, perhaps, been best summarized by Edwards (1979, p.31) as follows: "...despite our normal feeling that we are one person - a single being - our brains are double, each half with its own way of knowing, its own way of perceiving external reality".

The fact that the right hemisphere controls the left side of the body, and vice versa, has been known for centuries. In recent years, the different functions of the two hemispheres have been assessed by comparing the electrical activity from the left and right sides of the brain. Several researchers have observed specific functions associated with one hemisphere or the other (Sperry, 1973; Levy, 1968; Russell, 1979; Edwards, 1979; Restak, 1979). For instance, the sequential approach to information processing has been associated with the left hemisphere while the holistic approach has been associated with the right hemisphere. Still, little is known concerning the specific functions of each hemisphere. It should be observed that most research, so far, has been conducted with males. Recent research suggest that females may display some difference in brain configuration when compared with males. Thus, the concept of differential brain configuration seems to offer more flexibility and more generality to the study of brain functions than does the concept of hemispheric dominance. However, within the framework of the present investigation the hemispheric dominance terminology will be adopted as meaning particular brain configurations.

From his observations in brain injuries, Sperry (1967) concludes that the left side of the brain excels in tasks involving verbal abilities and speech related capacities while the right side dominates in non verbal tasks. Since 1960, a change in perception of the brain has led to recognize that "each half of the brain is specialized in complementary fashion for different modes of thinking, both highly complex" (Edwards, 1979, p. 29). New evidence found by Levy (1968) suggests that the two modes of processing tend to interfere with each other causing a sub-maximal performance.

According to several authors (Sperry, 1973; Levy, 1968; Ornstein, 1972; Russell, 1979; Edwards, 1971) the left hemisphere seems to operate in a more logical, analytic, computer-like fashion. It analyzes, abstracts, counts, marks time, plans step-by-step procedures, verbalizes, makes rational statements based on logic; it is dominant in analytic thinking, linear and serial processes, mathematical reasoning, logic, etc. On the other hand, the right hemisphere specializes in Gestalt perception, synthesis, non-verbal and parallel information seeking routes. Using the right hemisphere we can understand metaphors and dreams and create new combinations of ideas; one can synthesize, recognize patterns, create, etc.

These observations provide evidence that each hemisphere perceives reality in its own way. As stated by Edwards (1979, p. 30), "the mode of processing used by the right brain is rapid, complex, whole pattern, spatial, and perceptual - processing that is not only different but comparable in complexity to the left brain's verbal and analytic mode".

A CONCEPTUAL LINKAGE

The characteristics of left and right hemispheric dominances as well as those of the rational-empirical and metaphorical psycho-epistemic dominances are displayed in Table 1. The terminology used in reporting these characteristics has been borrowed from the respective references. For hemispheric dominance, the characteristics were extracted from Sperry (1973), Levy (1968), Russell (1979), Edwards (1979), Ornstein (1972). The characteristics of the psycho-epistemic dominance were obtained from the various documents produced by Royce and his collegues, in particular, Royce (1964, 1971, 1973, 1977) and Royce _et al_ (1975), and Royce and Diamond (1976).

Although brain hemispheric dominance and psycho-epistemic dominance have evolved from distinct research streams a comparison of

Table 1

A Comparison of Characteristics of Hemispheric and Psycho-Epistemic Dominances

Hemispheric Dominance	Psycho-Epistemic Dominance
Left Dominance	Rational or Empirical
	Verbal
Verbal	Analytic and relational
Analytic	High in spacial scanning
Symbolic	High in conceptual differentiation
Abstract	Math-modeler
Logical	Abstract
Objective	Reflective rather than impulsive
	Stresses individualization
	Field articulate
Rational	Reasoning
	Favours behavioral objectives
	High in compartmentalization
Linear	Literal as opposed to
Temporal	physionomic
Sequential	Sensory information
Digital	Sequential
Figuring-out	Emphasis on facts, numbers, details...
	Favors inductive and deductive reasoning
Right Dominance	Metaphorical
Non verbal	Fluency (ideational, expressional,
Synthetic	associational,...)
Concrete	Imaginative
Analogic	High in conceptual integration
Nontemporal	Low in compartmentalization
Nonrational	Physionomic as opposed to literal
Spatial	
Intuitive	Impulsive
Holistic	Original
Metaphorical	Subjective
Creatuve	Ideographic as opposed to nomothetic
Parallel information	High in semantic redefinition
Processing	
Whole-pattern	Non field-articulate
	Holistic
	Analogic
	Process-oriented as opposed to content-
	oriented
	Visual
	High sensitivity to problems

their characteristics display striking similarities. The same terms are used in several instances. With few exceptions, these terms are used with the same meaning in both cases. It should be noted that the two hemispheres as well as the three psycho-epistemic ways of knowing are activated in all kinds of situations. In the case of the brain, in some tasks one side may carry most of the load, in other tasks an alternation between the two hemispheres may take place, and yet in some other cases each half may even carry an equal share of the task. For psycho-epistemic styles, the same situation prevails; one may process information mainly through linear, sequential routes for certain tasks and through parallel routes for others; one may also alternate or involve a mixture of the two ways of processing information in some other tasks.

In summary, hemispheric and psycho-epistemic dominance means that individuals in general tend to favour one hemisphere or one epistemic style at the expense of the other. That is not to say that dominance excludes the use of the other hemisphere or other psycho-epistemic styles. However, environmental factors such as culture, family and schooling can often produce hemispheric and epistemic encapsulation that makes us look at life partially while issuing statements concerning the wholeness of living.

EMPIRICAL EVIDENCE

To our knowledge, no empirical study has been conducted to investigate the correlational relationships between brain hemisphericity and psycho-epistemic styles. However, some empirical evidence, supporting the existence of such a relationship has been gathered by Rancourt (1978) and Rancourt and Dionne (1981).

Within the context of learning strategies, using a programmed instruction approach, Rancourt (1978) found that low metaphorical subjects exhibited higher achievement than high metaphorical subjects. An analysis of covariance design produced an F-value of 33.61 with 1 and 61 degrees of freedom. These results match the expectations; the metaphorical group of student-teachers were expected to experience more difficulty and produce a lower achievement for they prefer to process information in holistic creative, synthetic ways; their rational-empirical counterparts were expected to perform well since they tend to process the information in analytic, inductive and sequential fashions.

As part of a recent study, Rancourt and Dionne (1981) identified the psycho-epistemic styles of teachers and learners, relative to their subject matter preference. It is interesting to note that no difference was observed between the distribution of psycho-epistemic styles of teachers relative to the area of specialization, the preferred subject matter and actual subject matter taught. Table 2 illustrates the relationship between the hypothesized epistemological characteristics of a subject

TABLE 2

Psycho-Epistemic Dominances among teachers and learners relative to preferred subject matter

Subject Matter	Status	n	Psycho-Epistemic dominance M	R	E
Fine Arts	Teacher	25	84.0	16.0	0.0
Math.	Teacher	79	20.3	50.6	29.2
Sciences	Teacher	80	28.8	37.5	33.8
Fine Arts	Learner	41	56.1	28.8	17.1
Math	Learner	38	13.2	52.6	34.1
Sciences	Learner	94	17.4	43.6	36.1

Dominance is determined from raw scores. M, R and E stand for Metaphorical, Rational and Empirical, respectively.

matter and the psycho-epistemic dominance of teachers and learners who preferred that subject matter. On the basis of those results, logical equivalence of subject matter and the logical equivalence of modalities of knowing are to be seriously questionned by educators.

CONCLUSION

The suggestion was made that the assumption of logical equivalence of subject matter on the one hand, and of modalities of knowing on the other, may have contributed to divergence of ideas, concepts and strategies in education. While empirical psychologists try to eliminate the metaphor (Skinner 1957, p. 428); while rational psychologists emphasize intellectual development and critical thinking (Piaget 1952, Ausubel 1953) and while humanistic psychologists defend personalization, creativity and self-realization in education, (Rogers 1961, Maslow, 1971) the search for a "best" learning or teaching strategy has not successfully answered McClellan's question (1962, p. 107) as to "How is knowing in mathematics different from knowing in science and in poetry".

Brain research and psycho-epistemology have in part offered a possible explanation to divergence of educational theories and have indicated that logical equivalence of subject matter and modalities of knowing must be seriously questionned.

Brain hemisphericity and psycho-epistemology were compared and the suggestion was made that the Psycho-Epistemic Profile offered potential in the assessment of hemispheric dominance although more empirical research is needed. More specifically empirical evidence was presented to show that students with a high metaphoric dominance produced significantly lower results on an achievement test than those students with a low metaphoric dominance when individualized instruction was used as a learning strategy. Data were also presented to show that a strong relationship exists between the epistemic dominance of teachers and learners on the one hand, and their preferred subject matter on the other.

Although psycho-epistemic matching of the various elements of the educational process is quite possible, and in some cases desirable, it can lead to further encapsulation and divergence. Since Royce (1975) suggested that psycho-epistemic styles can be learned and utilization of the three styles can lead to a more integrative and holistic life, some consideration should be given to the inclusion in curricular programmes at the secondary and post-secondary level, mediated instructional modules on the use of rational (deductive) thinking, empirical thinking (inductive) and metaphorical thinking (analogical). Such instructional modules would foster in the learners an awareness that might be translated as follows: "At last I realize why I succeed better in some subjects than in others and I'm learning what to do about it".

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LEARNING HIERARCHIES IN INSTRUCTIONAL DEVELOPMENT: EXPERIENCES AND DIRECTIONS FOR RESEARCH

by

George A. Reid, Jr.

Sarasota County Schools
Sarasota, Florida 33577

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George A. Reid, Jr.

1870 Irving Street

Sarasota, FL 33577

Office: 924-5800, or 953-5000(area Code 813)
Home: 813-365-2117

ABSTRACT

Learning hierarchies can provide a powerful referrent for the instructional developer, guiding the sequencing, step size, and inclusion of content in many instructional areas. Learning hierarchies are developed by analyzing the target skill of instruction, a task usually accomplished by a team of subject matter experts and an instructional designer. The resulting hypothesized hierarchy contains skills expressed as behavioral objectives and interconnections among skills indicating learning dependency relationships. To date, there is no catalogue of validated hierarchies available to the instructional developer. One must usually generate one's own hierarchies for a particular purpose. Since many important and costly decisions depend upon the validity of the hierarchy, the developer should make some attempt at assuring its validity.

The research literature concerning hierarchies does not provide much assistance to the instructional developer seeking practical validation procedures. Early validation studies have been criticized as being too imprecise and non-rigorous. The research literature, therefore, is pointing toward more tedious methods of validation in an attempt to evoke more conclusive research in the area. Simply posttesting a group of students on all the skills of the hierarchy seems to be a reasonable approach to validation. However, this method is suspect due to the controversy concerning learning sequences of skills vs. retention sequences of skills. Are they the same or are they different? Posttesting measures retention only,

because instruction is not involved. The intent of the developer is to find hierarchies of learning.

A recent study by White and Gagné (1978) indicated that posttesting produces validation results very similar to those produced by more rigorous methods involving instruction. Furthermore, their findings suggest that learning and retention sequences may be the same. This study is important because it suggests that the posttesting method may be entirely adequate for instructional development purposes and it provides the developer with a practical means for hierarchy validation.

In the section to follow, the literature concerning hierarchy validation will be reviewed. Certain practical and theoretical questions will be discussed which indicate the need for further investigation extending the study by White and Gagné. The second section of the paper contains practical suggestions for the instructional developer based upon research and practical experience with learning hierarchies.

REVIEW OF RELATED LITERATURE

Systematic Instructional Design

The field of instructional design provides a systematic approach to the design and development of instructional materials. Instructional design is founded on the premise that materials designed in accordance with the steps of a systems approach model will be most effective and efficient in accomplishing an instructional task. The procedures used by instructional designers are usually applied to the development of instructional materials. The materials are meant to be consumed by teachers or training managers, and are typically designed to produce learning results without significant involvement of the persons who have adopted the materials. This discussion is particularly addressed to instructional developers involved in these efforts. However, the rationale and directions for needed research are relevant for designers of instruction with varying degress of self-containedness, including teacher-presented instruction.

The steps of the systems approach model are based upon theories of learning and general systems theory. One widely cited example of a systems approach model is that of Dick and Carey (1978). A diagram of that model appears below (Figure 1).

Two features of the systems approach particularly distinguish this approach from traditional methods of instructional materials development. Those features are (1) conducting instructional analysis and (2) designing and conducting formative evaluation, which appear as steps two and seven, respectively, in the systems approach model (Figure 1). In the formative

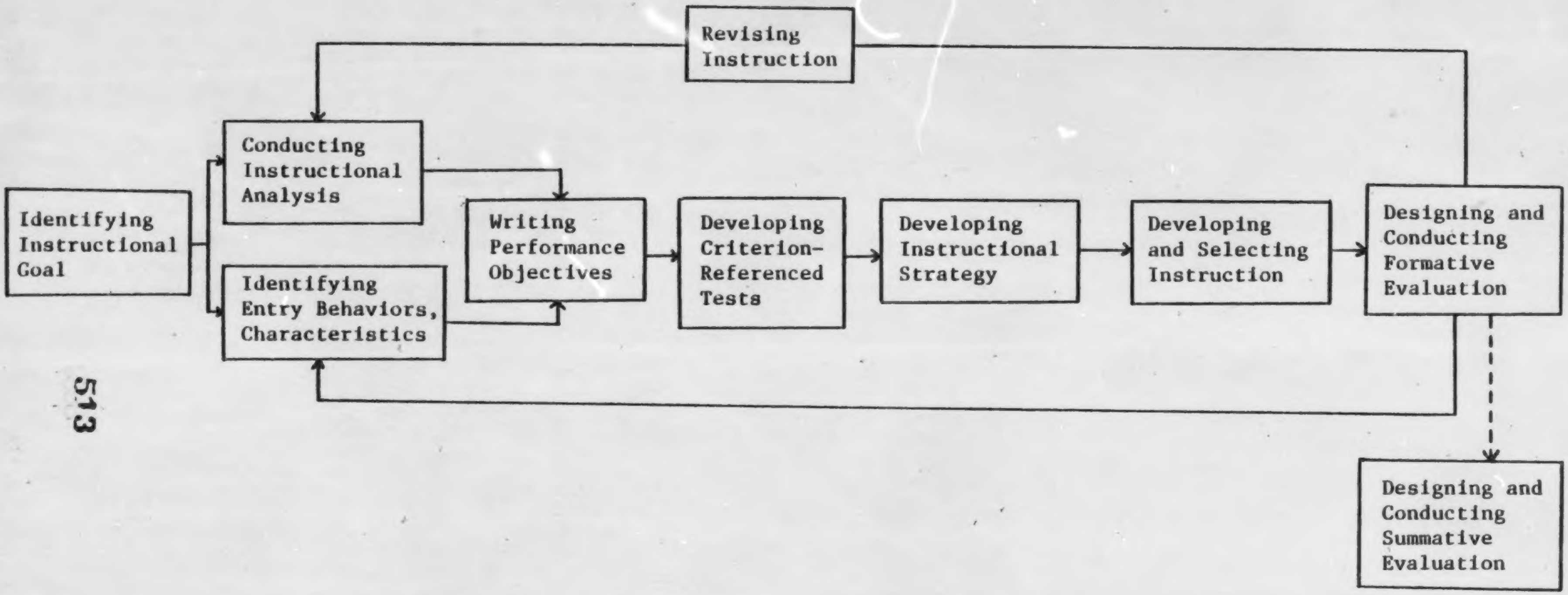

Revising Instruction
Conducting Instructional Analysis
Identifying Instructional Goal
Identifying Entry Behaviors, Characteristics
Writing Performance Objectives
Developing Criterion-Referenced Tests
Developing Instructional Strategy
Developing and Selecting Instruction
Designing and Conducting Formative Evaluation
Designing and Conducting Summative Evaluation

Figure 1. Systems Approach Model for Designing Instruction
(Dick and Carey, 1978)

evaluation step, materials are evaluated while still in the formative (i.e., draft) stages of development. During formative evaluation, draft materials are presented to learners and data are collected concerning the clarity of directions, illustrations, and practice problems, as well as whether the materials are successful in "teaching" the target skills. Usually, materials are presented to subject matter experts for criticism of the content. Materials are then revised based upon the data collected. The earlier step, that of instructional analysis, will be focus of attention of the discussion to follow.

Instructional analysis

Instructional analysis, an early step in the systems approach model, involves the analysis of the final goal or objective of instruction. In instructional analysis, each objective of instruction is broken down to reveal the necessary steps that the learner must take in order to learn the skill or knowledge specified by the objective. By revealing an hypothesized pathway for learning, a corresponding strategy for instruction should emerge. A companion step in the model (Figure 1) is that of identifying entry behaviors. Here, the minimum prerequisites for beginning instruction are specified from the instructional analysis and from what the typical learner already knows or can do. Instruction is expected to take the learner from this entry level, through some instructional strategy, finally exiting instruction having acquired new skills or knowledge.

There are at least two types of instructional analysis which are useful to the instructional designer. Two types of analyses are procedural task analysis and learning task analysis (Gagné, 1977a; Dick and Carey, 1978). Procedural task analysis is done when the task to be learned consists of steps or procedures to be performed by the learner (such as carrying out long-division or changing an automobile tire). To perform the objective task, the learner must have learned and must recall each step individually, as well as the sequence of steps and any decision rules involved with the steps. There are various instructional strategies appropriate for teaching procedural tasks. Regardless of the teaching strategy selected, designing the strategy will be aided by a diagramming of the procedural steps involved.

The second type of instructional analysis is termed learning task analysis or hierarchical analysis. Hierarchical analysis is particularly suited to learning objectives which are intellectual skills (Gagné, 1977b). According to Gagné, the intellectual skills include problem solving, rules, defined and concrete concepts, and discriminations. These intellectual skills "make up the bulk of what is learned in school" (Gagné, 1977b). Hierarchical analysis of an intellectual skill reveals other skills which must be recalled from previous learning in order to learn or demonstrate a new intellectual skill. The subordinate skills revealed by analysis are termed prerequisites. According to the theory of learning hierarchies, these prerequisites must be learned first before the learner can meaningfully learn or perform the skill which was analyzed. The following paragraph exerpted from Gagné explains the idea of prerequisites:

> The basic idea of prerequisites is simple enough. When a young student undertakes to learn how to write an expository sentence, he must be able to recall, as prerequisites, some words to place in the sentence. Another obvious prerequisite that must be possessed is a set of rules for placing differing types of words in a proper order, so that an "agent" word comes first, followed by an action word, and this in turn followed (as one alternative) by an "object" word. It is not difficult to realize, either,

> that this set of syntactic rules themselves have prerequisites -- the identification of words as belonging to the classes "agent," "action," and "object." Other examples occur in mathematics: sums of single-place numbers are prerequisite to the adding of multiple-place numbers; multiplying numbers is a prerequisite to long division (Gagné, 1977a, p. 130).

Learning hierarchies

White (1974a) said of learning hierarchy theory that "of all the existing learning theories, this seems to have the potential of being most direct in its application to classroom learning...." In a major review of hierarchy research, White (1973) found positive but inconclusive support in the literature for the existence of learning hierarchies. Problems in validation methodology, mainly, were cited as the reason. Also, many researchers had confused rote knowledge or verbal information, which is not theorized to be learned hierarchically, with intellectual skills. In applying the revised validation methodology suggested by White (1974b), "the most unequivocal evidence yet obtained for hierarchies" was presented by White (1974a) in a study involving basic kinematics skills. In another paper, White and Gagné (1974) concluded that past studies have provided "fairly consistent support" for learning hierarchy theory.

The usefulness of learning hierarchies has been demonstrated in studies by Cook (1969) and by Fiel and Okey (1975). A recent investigation by Trembath and White (1980) found that a learning hierarchy used in conjunction with mastery learning produced remarkable results with a difficult intellectual skill. In this study, using a previously validated hierarchy involving calculating velocity from a position-time curve, students with instruction guided by the hierarchy learned the task significantly more efficiently than a group of students three grades higher using traditional instruction.

Validating Learning Hierarchies

Most research reported in the literature since the preliminary study by Gagné (1962) has been concerned with proving or disproving the existence of learning hierarchies. Research methodologies included a procedure for testing hypotheses about relationships between pairs of skills. These hypotheses were, generally, one or both of the following: All the learners who can perform skill II (i.e., have learned the skill) can also perform skill I. That is, the capability to perform skill I is a necessary condition for the performance of skill II. The other type of hypothesis was that learners who can perform skill I will be able to learn skill II more efficiently than learners who are not required to learn skill I first. Investigating the latter hypothesis would be investigating the "positive transfer" hypothesis.

Early hierarchy studies (Gagné and Paradise, 1961; Gagné, Mayor, Garstens, and Paradise, 1962) employed a method of teaching naive students the skills of a hierarchy, followed by administration of a posttest of all skills arranged in random order. White (1974b) criticized these and other studies conducted in the preceding decade and listed several shortcomings, summarized below.

1. Hierarchies were not always checked to ensure a "common sense validity" before collecting empirical data.

2. Many studies used too few students.

3. Hierarchy elements were indiscreetly or loosely defined.

4. Tests sometimes included only one item per objective.

5. There was too much delay between instruction and testing

6. Investigators did not always look for additional hierarchical connections; only those postulated were tested.

7. No objective method was used consistently to determine validity.

8. Verbal information or rote knowledge was often included in the hierarchies to be investigated.

White proposed a nine step model to overcome those shortcomings, as follows.

1. Define, in behavioral terms, the element which is to be the pinnacle of the hierarchy.
2. Derive the hierarchy by asking Gagne's question("What must the learner be able to do in order to learn this new element, given only instructions?") of each element in turn, from the pinnacle element downward. Include all connections that seem reasonably possible, since the validation process can only destroy postulated connections, not create them. Avoid verbalized elements, they can be included in the instructions.
3. Check the reasonableness of the postulated hierarchy with experienced teachers and subject-matter experts.
4. Invent possible divisions of the elements of the hierarchy, so that very precise definitions are obtained.
5. Carry out an investigation of whether the invented divisions do in fact represent different skills.
6. Write a learning program for the elements, embedding in it test questions for the elements. The questions for an element should follow immediately after the frames that teach the element. There must be two or more questions for each element to allow for an estimate of their reliability.
7. Have at least 150 students, suitably chosen, work through the program, answering the questions as they come to them.
8. Analyze the results to see whether any of the postulated connections between elements should be rejected.

9. Remove from the hierarchy all connections for which the probability under H_o is small, say 0.05 or less (White, 1974b, p. 2).

With the acceptance of the basic hypothesis of learning hierarchies, validation methodologies are being looked at for reasons other than for research into learning hierarchies. Having the potential for application to classroom learning and instructional development, validation methods must be found to insure the soundness of developed hierarchies if they are to be the basis, for example, for sequencing decisions for instructional programs. The White (1974b) method was offered to researchers for the purpose of avoiding validation shortcomings observed in previous studies, encouraging more rigorous and conclusive research into learning hierarchies. White and Gagné (1978) point out that this rigorous validation method has been avoided as being too impractical for instructional development. This situation has left the instructional developer without a validation methodology for hierarchies and may have precluded the widespread application of hierarchy theory to instruction.

Hierarchies in instructional development

A recent study by White and Gagné (1978) has set the stage for practical validation of hierarchies by instructional developers. In the study, White and Gagné compared previously obtained validation results for a graphical kinematics skill, which were obtained using White's (1974b) procedure, with a short-cutted validation method. The abbreviated method essentially involved posttesting students who were taught the skills involved in the hierarchy as a part of their regular courses in mathematics and science. They obtained results which were "similar" to those obtained through rigorous validation, and concluded that the simplified procedure was "sufficiently accurate" for application to the evaluation of instructional materials. Additionally, the results suggest that hierarchies based upon retention (i.e., from the results of posttesting) are identical to learning hierarchies. This psychometric validation is confirmatory in nature.

Dick (1980) commented that the abbreviated methodology could be further simplified by determining the percentage of students who mastered each skill of the hierarchy, and approximately the same validation information could be obtained. This procedure avoids the necessity to tally results to compare each pair of skills in the hierarchy. Dick reanalyzed the White and Gagné (1978) data, presenting nearly identical validation results.

Interaction of teaching/learning mode and the hierarchy

It has been suggested that there may be differences in learning hierarchies depending on where a set of skills was learned (Wang, et al., 1971). Validation results, therefore, would be subject to differences depending upon differences in the mode of instruction or learning. Wang, et al. suggest that there may be "natural" sequences where formal instruction is not involved and that schooling may impose "artificial" sequences on learning. This idea can be extended to imply that different instructional treaments may impose different learning and/or retention sequences. White and Gagné (1974), in identifying areas of needed research, also suggest that studies be carried out to confirm the generalizability of hierarchies across teaching modes. Wang, et al. (1971) propose that natural sequences should be determined and that those results would guide the development of optimal instruction.

Individual differences or aptitudes

There may be individual differences which interact with the sequencing or content of a learning hierarchy. This question has been explored by Resnick (1973). Resnick points out that in at least two studies reviewed, students did not learn behaviors in the hypothesized order, but were found later to have learned prerequisites simultaneously with the more complex task. These results are consistent with hierarchy theory.

It is reasonable to suggest that differences in the nature of subskills required for a terminal skill may vary for individuals, as well as differences in the level of analysis required. Glaser (1973) suggests that intelligence may determine the level of analysis (fine vs. gross breakdown of subskills) required for a given population of students. Cronbach and Snow (1977) reviewed studies which suggest that intelligence may interact with the rate or step size that a student uses in moving through a hierarchically structured learning program, but do not venture conclusions concerning other individual aptitudes which might interact with the structure of a learning hierarchy. Resnick (1973) also discusses hierarchies with "disjunctive branches" or those with independent routes of subskills leading to the same terminal skill. The idea of disjunctive branches opens the possibility of one individual learning a skill through one route, and another individual learning the skill via another.

If different learning routes or hierarchy structures exist for a terminal skill it would be useful to reveal these independent of instruction. Validation with instruction may mask individual differences or different routes, precluding finding optimal learning structures. These questions must also be considered if one expects to validate a hierarchy with one population and use the instruction developed from the hierarchy with another population.

Theory-Based Formative Evaluation

There are directions for research both theoretical and practical from the field of instructional design and formative evaluation. In applying a systematic design procedure such as that of Dick and Carey (1978), the instructional developer would carry out instructional analysis as an early step in the design process. If the developer is dealing with intellectual skills, a learning hierarchy would be the result. Dick and Carey outline a validation method for the hierarchy which would be done along with the tryout of instructional materials. More recently, Dick (1980) discusses the advantages of validating prior to the development of instruction. If many hierarchies are to be validated, the implications for revisions to instruction and tests if many problems are found could be extensive and costly.

Martelli (1979) discusses the question of early validation of hierarchies in the context of theory-based formative evaluation (see Fitz-Gibbon and Morris, 1975). Essentially, the theory of learning hierarchies would be evaluated at the time of occurence of the instructional analysis step in the design procedure, to ensure that implementation of the theory-base was being carried out properly. This would be done for each step of the systems model which is based upon theory. For hierarchy theory, the result would be a validated hierarchy obtained before moving to the next step in the design model. Martelli presents results of a study which suggests that more effective instruction would result from practicing theory-based formative evaluation.

Directions for future research

The study reported by White and Gagné (1978) investigated a method for formative evaluation of a learning hierarchy. An abbreviated validation method was proposed for use by instructional developers. Their proposed method would require fewer calculations and would not require the development of instruction in order to validate the hierarchy. The results of applying their simplified method to the validation of one hierarchy which was previously validated by White (1974a) indicate that essentially the same results are obtained. The essential difference between the two methods is that the simplified method involves validation by simply posttesting as opposed to validation with instruction. As White and Gagné (1978) point out, the simplified method is validating the hierarchy based upon retention.

The results of the White and Gagné study are attractive to the instructional developer. Applying this simplified methodology for the revision of a hierarchy early in the design/development process could provide a potential savings in time and effort, especially where a large number of skills are being dealt with and many hierarchies would require validation. Their results are also relevant in examining several other more theoretical questions raised previously, such as retention vs. learning sequences and the generalizability of hierarchies across teaching or learning modes. The White and Gagné study is based upon only one hierarchy or set of skills. If the simplified, posttesting method could be demonstrated as producing results similar to those with a learning program, with several sets of skills and with a range of content, the instructional developer would feel more comfortable in applying the simplified method. The practical and theoretical questions raised indicate the need for further studies comparing the posttesting method with validation with instruction.

Directions for Future Research

The preceding discussion leaves several areas open for research. There are certain research questions with direct relevance for the instructional developer. Other questions are more theoretical in nature. Some of the questions listed below were previously outlined by Gagné and White (1974).

1. Does posttesting produce results similar to those obtained by validating with instruction?

2. Is the retention hierarchy the same as the learning hierarchy?

3. Do valid hierarchies exist in subject areas other than mathematics and physical science?

4. Are hierarchies useful as a reference for the classroom teacher (or will their use be limited to instructional development)?

5. Do subordinate skills mediate transfer to the higher skill in a hierarchy?

6. Are hierarchies generalizable across teaching modes?

7. Are hierarchies generalizable across individuals?

HIERARCHIES IN INSTRUCTIONAL DEVELOPMENT: PRACTICAL GUIDELINES

Why do instructional analysis?

There are many conditions which must be present for learning to occur, such as learner motivation and the opportunity to practice a new skill. The instructional developer looks to learning theory and research for guidance in order to incorporate as much insight as possible into the design of materials. No condition of learning is more important than the presence of relevant prerequisite skills when a learner faces the task of learning a new skill. A learning hierarchy, therefore, should always be consulted when the instructional developer is dealing with an intellectual skill in instruction. The payoffs realized from spending the time to develop a learning hierarchy will be just as great as those realized from a careful consideration of the instructional strategy and media to be developed in instruction.

Validating the hierarchy

The hierarchy should be validated before the instruction is drafted, otherwise, necessary content may be omitted, unnecessary content may be included, or lesson sequencing may be incorrect. Validity information can be obtained from expert review and from a test of all skills in the hierarchy given to a sample of the target population. The hierarchy should be as good as it can be prior to the drafting of instruction. In conjunction with the formative evaluation of instruction, further information may be obtained to validate or revise the hierarchy, if necessary.

Hierarchy development and validation: A procedural model

1. First of all, develop instructional objective statements for the skills or knowledge which are the target of instruction. A sample test item, or better, test specifications or item forms which define the skill domain should accompany the objective statements. If the objectives indicate intellectual skills (as opposed to verbal information or rote knowledge, motor skills, or attitudes), then a hierarchy will be useful for instructional development. Sometimes, procedural tasks contain intellectual skill components, even though the terminal skill for instruction is not wholly an intellectual skill.

2. Once agreement has been reached on what are the target skills, analysis can begin. Hierarchies are best developed by a team, and three persons seems to be an optimum number. Suggestions for team member roles are as follows: (1) A content or subject-matter expert. (2) A teacher or trainer/instructor with experience in the content area. This person is the "learner advocate", with knowledge about how students learn. (3) An instructional designer, with a knowledge of hierarchy theory. This person keeps the team on task and provides the process for analysis.

3. The team should analyze one target skill at a time. Make sure that the objective domain is defined by providing a sample test, etc. The team begins by asking THE question: " What must the learner know or be able to do, first, before he can learn this new skill, given only instructions?" At this first point of analysis, it is best to brainstorm the domain of related subskills, without arranging or making judgements of importance. To facilitate making the hierarchy, write each brainstormed skill on a 3 x 5 (or similar) card. After several skills are listed, go through each as a team and decide whether it is (1) necessary, (2) not sure, or

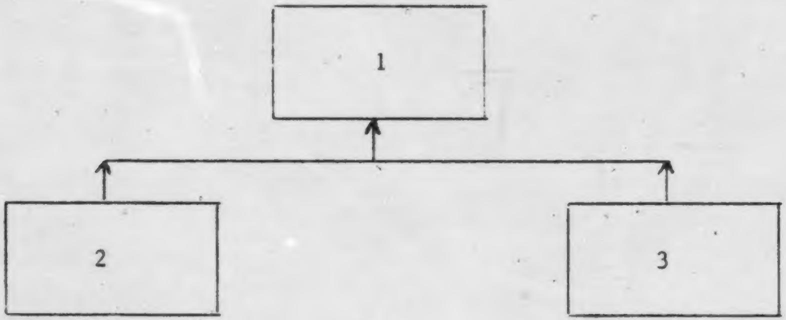
(3) irrelevant. Save (1) and (2) for hierarchy development.

4. Subskills should now be placed under the card indicating the target skill, showing the relationships among subskills. The cards can be layed out on a table and arranged under the top skill. The initial task is to find all subskills which lead directly into the top skill, but other relationships will be realized as well and these can be diagrammed with the cards. Eventually, the question will be asked about each subskill placed in the hierarchy. The analysis is complete when each skill that has no subskills can be considered an entry skill for the target population.

5. The next step is to review and revise the hypothesized hierarchy. This is best done by allowing another team to look at the hierarchy, but first, the developing team should go through a review/revision step. This review is facilitated if, at this point, a sample test item or domain specification is written on the back of the each 3 x 5 card. Often, this redefinition of the skill will result in revision to the hierarchy. When the developing team is satisfied, the cards can be taped onto a large piece of newsprint and connecting lines can be drawn. If this is too cumbersome to transport, the draft map can be typed out on a page and the sample test items can be appended.

6. The draft hierarchy should be reviewed by the same kind of team that developed it. The review should be directed according to the following guidelines.

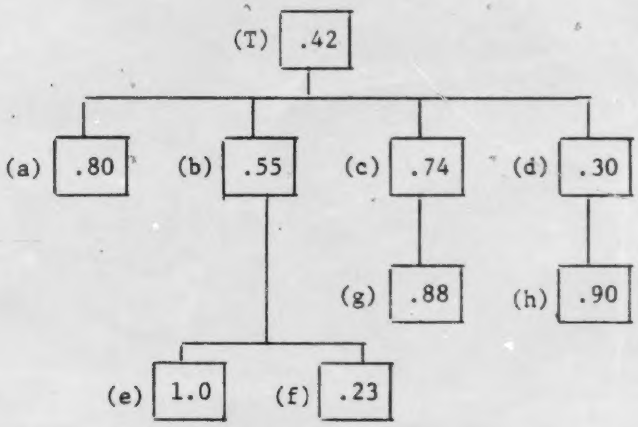
The Review/Revision Process



1. Examine each individual connection of the hierarchy according to these requirements:
   a. # 1 cannot be learned unless # 2 and # 3 are learned first (or learned concurrently)
   b. If a student were tested on # 1 and mastery is indicated, we can be sure that he would also master # 2 and # 3 if tested.
   c. # 2 and # 3 will become a part of # 1 once # 1 is learned. That is, they are components of skill # 1.
2. Look for completeness. Are all necessary subskills listed?
3. Look for inclusion of extra skills. Skills may be "nice to know" or may be traditionally taught in the course, but are they necessary?

7. Some general suggestions for the preceding steps are the following. (1) Do not use scope and sequence charts, objective listings, or teaching programs as an initial reference in developing the hierarchy. The target skill and test item(s) should be the only reference. Such material may be useful after development, during the review process. (2) Objectives or subskills should be divided where possible to give very precisely defined elements. A sample test item developed for divided elements will usually indicate whether or not you actually have two or more discreet skills. (3) Include all reasonable elements and connections. Validation and review procedures can only destroy connections and usually won't pick up something which was missed.

8. Write at least three test items for each element of the hierarchy. Use more items only if necessary for domain coverage. Place the items in random order to construct a test for each hierarchy. The test should be administered to students who are similar to the target population for instruction. The students should have studied the topic of instruction, giving a range of masters and non-masters on hierarchy elements. As many students as practical should be tested, but Dick (1980) suggests that "as few as 15 students can provide valuable data for the designer." If three items are used, then at least two of three would be passed for mastery of the hierarchy element. Validation information is obtained by diagramming the proportion of tested students mastering hierarchy elements, as below. This method was initially described by Dick (1980).



The test data indicate that element (f) is not necessary in order to learn (b). Also, element (d) is not necessary for (T); however, element (h) may be necessary if reasonable to connect it directly to (T). All other proportions are consistent with the hypothesized hierarchy. An accept/reject decision should be made for each pair of connected skills.

Developing instruction from the hierarchy

If the writers of instruction have not used hierarchies as a guide before, there may be a temptation to take the hierarchy too literally. This was experienced when elementary teachers were asked to draft learning activities (self-instructional modules) for an externally funded project. Possibly, since hierarchies were new to them, instructions for their use may have been overstated by the instructional designer. Simply stated, it is not necessary to develop one lesson for each hierarchical element, nor must the lessons follow a sequence strictly defined by the hierarchy. Creativity and insights from teaching experience should guide the writing process. The hierarchy dictates what must be included along with a specification of entry skills. The hierarchy provides a sequence which must not be violated, i.e., prerequisite skills must be taught first, or taught concurrently, before introducing more complex skills. It also follows that embedded test items should be included to allow the learner to decide if he is ready to move on to the next lesson. There are a number of ways to approach the writing task. One is to take the hierarchy as a basic core, and to elaborate on it with notes, etc., indicating an outline for instruction. Another way would be to set the hierarchy aside, and just begin writing as guided by creativity and intuition. Then, at various steps along the way, the hierarchy could be studied to insure that the above requirements were being met.

As described by Dick and Carey (1978), the hierarchy can provide much insight for formative evaluation by displaying pretest, embedded test, and posttest performance of students hierarchically. Reasons for failure on complex skills can sometimes be traced to incomplete learning of a prerequisite. Also, further information can be collected regarding the validity of the hierarchy.

Using hierarchies in classroom instruction

In addition to providing a primary reference for the developer of instructional materials and media, hierarchies can also be useful to the classroom teacher. The hierarchy can be used in preparing teacher-presented instruction in much the same way as the materials developer would use the tool. A hierarchy can also be very useful in diagnosing learning problems and in prescribing the content of needed remedial instruction. As with the writing of instructional materials, teachers given hierarchies often take them too literally. "Hierarchy" does not equal "curriculum!" There is no more powerful tool for curriculum development than hierarchical analysis (it may be as important as a good needs assessment). However, the hierarchy should not dictate the total of what is to be taught. The hierarchy does not state that every student must master every element, taught in tiny steps in the order shown. The hierarchy provides a core of necessary prerequisites for learning an important terminal skill. It is to be built upon through the addition of supportive content and ingenious instructional strategies and materials.

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Affective Responses to the Literary and Cinematic Elements in an Educational Film: A Descriptive Investigation

Dr. Rhonda S. Robinson
Northern Illinois University
DeKalb, Illinois 60115

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Affective Responses to the Literary and Cinematic Elements in an Educational Film: A Descriptive Investigation

INTRODUCTION

How do students view an educational film? That is, how do they perceive the images; how do they learn from the flowing sequences of motion visuals; to what do they attend? What is central to the understanding of how film works in the classroom?

These are certainly valid questions; questions which, however, may never be fully answered. The film image is elusive; attempts to answer basic film questions are ongoing. This study attempts to answer such questions by considering an educational film and its effects on a particular audience.

BACKGROUND TO THE PROBLEM

The study itself, its background theory and ideologies, has several interwoven strands. Any investigation in the use of film as a communication tool and an artistic experience will have many branches. For example, Sol Worth (1974) has delineated five major areas of research into the use of film in education, and has further identified three "major perspectives . . . involved in the analysis of the nature and effects of film" (p. 274). Worth assumes three current ideologies of film.

For the purposes of this study, the following three perspectives were delineated. First, a film theory perspective, looking at the aesthetic considerations of film as art. Second, an educational film research perspective, considering the results of studies investigating the cognitive and affective domains of learning and the abilities of film as an educational tool. And third, and educational perspective, looking at the importance of film in education, as a visual and verbal mode of expression, a language, an expanded form of literacy.

Film as an Artistic, Visual Experience

Film is a visual, moving educational experience when thoughtfully utilized as part of the classroom curriculum. Students do learn new concepts and skills (Hovland, Lumsdaine, Sheffield, 1949; VandeMeer, 1945; Rulon, 1933), and experience new sights through well produced educational films (Wegner, 1977; Hovland, Lumsdaine, Sheffield, 1949). Students may be missing part of this visual experience, however, if the educational content of the film is considered without considering the aesthetic component (Wagner, 1978; Wegner, 1977; Lacey, 1972; Sheridan, et.al., 1965). Students are influenced by both the form and the content of a film, and that fact suggests that students should then be made aware of the total experience, to "develop taste and appreciation" for film, as they have for "the traditional arts and humanities" (Culkin, 1972).

Educational films are sometimes extremely well produced visual messages. Students who learn to be more visually aware of the power of cinematic production may indeed learn more and better appreciate the message itself. Film does teach well (Hoban, 1950; Hovland, Lumsdaine, Sheffield, 1949). How films teach, and to whom they best teach, are currently being investigated (Salomon, 1979; Wagner, 1978). But many educational film researchers are now pointing out that one important question has yet to be explored: how do the aesthetic elements of an educational film affect their audience?

Students are trained in literary criticism, but not, it would seem, in visual literacy. The term visual literacy has been given many interpretations and definitions. For the purposes of this inquiry, it is defined considering both the technical and more affective elements. Visual literacy is "an understanding of how the structural devices basic to all films -- composition, lighting and color, movement, editing, sound, and rhythm -- influence the viewers' responses" (Foster, 1979, p. 3). However, as Morrow (1980) has pointed out, media literacy must also include conceptualization, creativity, wit, imagination. This visual literacy involves the ability to "recognize and discuss how a filmmaker uses visual images to make us feel and think" (Greiner, 1979, p. 37).

The educational film One Eyes Men Are Kings was chosen for this study because it is predominantly visual and emotional. It is a narrative film whose "structural devices", visuals and musical sound track, develop the film story, a story designed to "make us think and feel." It provides a visual, literary experience to which students may respond and offer interpretations.

Problem Statement

Ethnographic, observational research is often based on a comparison between aspects of the environment being examined, in order to strengthen, direct and differentiate the response or observations (Denzin, 1978). In this study, which asks how an educational film is received and understood, a comparative basis was chosen to provide such direction without limitations. The film was recorded on 3/4" videotape, and the two modes of presentation, film and videotape, were used for comparison.

The purpose of this study was to investigate the difference in cognitive and affective responses of students to a short, educational film and to a videotape presentation of that film. The cognitive response involved students' understanding of the story elements of this film: plot, setting, character, mood, theme. The affective response involved their appreciation and reaction to both the story or theme and to the cinematic elements of the film. (The film was a non-narrated, dramatic story, told through music and visuals alone with a melancholic theme.) The detailed student responses to this film or videotape were also examined. This study attempted to describe the students' visual understanding of the construction of the film, and how that construction led to their reactions. The questions under consideration were: 1. how do students view a film; 2. how does the film create its affect; and 3. how do the knowledge of cinematic and literary elements affect the student response?

This study investigated the responses of eighth grade students to an affective, non-narrated short film or videotape. The impact and comprehension of both the literary and the cinematic film elements were observed and recorded. Three methods of data collection, observation, survey, and interview were utilized to discover the film or videotape viewing experience.

When the observational method was employed, certain specific questions were formulated as a focus for the study:

1. Did the students display literary knowledge of this film?
2. Did the students display cinematic knowledge of this film?
3. Through observable behaviors and attitudinal measures, did students exhibit a change in attitude after viewing the film? Which students exhibited the greatest change in attitude after viewing the film:
    a. Students who were most literarily knowledgable?
    b. Students who were most cinematically knowledgable?
4. What could be observed as an effect of maturity or better classroom articulation skills?
    a. Were cinematically literate students also those who were most articulate?
    b. Through interviews and observation could it be determined that students were affected by the film or videotape, even though they could not articulate their response in class?

5. What format, film or videotape, provided the clearest affective responses from students?

6. Did students respond normally in the presence of classroom observers?

   a. Did students respond honestly to interview questions?

   b. Was classroom behavior altered by observation?

   c. Were students interested in the film, and in the study?

These questions focus the discussion of conclusions which have been drawn from the study.

Research Methods - A descriptive, observational methodology was one method selected for this study. Direct observation of student behaviors while viewing the film or videotape and participating in discussion was considered the primary data collection method. One objective of the study was to determine the affective responses of the students, and the emotional impact of the film viewing experience. By direct observation of students' posture, facial expression, verbal responses, and general physical appearance and direction of attention, student affective responses to the film/videotape were noted.

The second data collection method employed in each case study was a survey of student attitudes. This questionnaire included a scale utilizing both attitudinal items and factual items. This questionnaire contained film or videotape narrative comprehension questions, attitudinal questions, and biographical questions. It was designed to further investigate the students' affective response to the film or videotape, as well as their comprehension of the narrative. The biographical questions were designed to investigate students' viewing patterns in and out of school, students' ages, and students' level of familiarity with filmmaking and film study.

Sample questions included: "After watching this film I felt: happier--the same--less happy--sad--depressed;" "Why did the man pretend to be blind? 1. to get attention; 2. to make friends; 3. to get sympathy; 4. so people would treat him better; 5. other reason;" and "Have you studied filmmaking in any class?"

With students' individual responses to the questionnaire, this second method of data collection was designed to allow non-observable reactions to be investigated. Such information was informally compared with information gained through observation.

The third method of data collection within the research design was a semi-structured interview. Some students and all participating teachers were interviewed following the class period in which the study was conducted, to obtain individual, personal responses to in-depth questions. The interview instrument was designed to obtain detailed responses from students, eliciting their opinion of the film or videotape, the discussion in class, the impact of the film message, and of the overall experience. Sample interview questions included: "Did you understand this film (videotape)? What was its message?"; "Did the class act differently today than usual?"; and "Would you recommend showing this film (videotape) to other eighth graders?"

Teachers were also interviewed, to gain insight into their reactions to the class participation, the film or videotape itself, and the study experience. Sample questions included: "Would you use this film (videotape) again in class?"; "Was this discussion today different or unusual?"' and "Have you noticed a student preference for film or for videotape as modes of projection?"

The design, methods, materials and instruments were all based upon normal classroom procedures and events. The film or videotape chosen was one often selected and utilized with junior high school English classes in many school systems. This film or videotape also allowed investigation or film comprehension including the narrative, non-verbal nature of the message, and comparisions in the mode of projection. The observation instruments, techniques, and the other instruments were all generated and pre-tested in this pilot; the discussion questions, the interview questions, the protocol, and the observation technique were all pilot tested. The observers discussed all of these procedures both before and after the pilot study was conducted, so that agreement and understanding was reached during and after the pilot.

Participant Sample

All of the three classroom teachers were chosen because they normally used short films as part of their classroom curriculum, and because their classroom discussion techniques were similar. These teachers also were willing and interested participants, previewing the film, arranging for the parental permission slips to be collected, and offering comments and suggestions before the study.

The student population consisted of eighth grade students attending classes at two schools, a middle school, grades 6-8, in a small town outside Madison, and a junior high school, grades 7-9, in a western Chicago suburb. The students range in age from 12-14, and their abilities and I.Q. ranges were the average spread for their ages. The classes were heterogeneous, and the courses in which the study took place were required English classes.

This study utilized this holistic approach to investigating students' perception of a non-narrated film. The study attempted to investigate the viewing experience as an entity, and to then examine certain characteristics of the structure such as the literary and cinematic elements. Students were observed throughtout their viewing and responses to the viewing. The experience as a whole was then interpreted to relate the impact of the interaction of participants, surroundings, atmosphere, and the visual display. The affective elements of a film could only be investigated as the interaction of the aesthetic form, the literary content, and the affective responses of the perceivers.

Conclusions

Literary Knowledge

Students revealed a strong understanding of the literary elements of the film or videotape. From observation of classroom discussions, it was clear that students understood the basic theme and plot structure.

Cinematic Knowledge

From all the indications, it was clear that some students did understand the literary elements of the film or videotape.

The students expressed only a moderate awareness of the cinematic elements under investigation. They could detail the rhythm or pace of the narrative, but only as it was related to the musical sound track. They could describe settings, color and some elements of shot or scene composition, but not to any great detail. They were aware that the film or videotape time was not equal to real time, but no student mentioned editing or cutting as the cause of the nonreality. The students accepted film or videotape time as reality; they accepted the narrative as real. This acceptance indicates that the literary and the cinematic elements of the film were combined in a manner which created a realistic, engaging message.

Earlier studies have examined students' cinematic knowledge (Hovland, Lumsdaine, and Sheffield, 1979; Wall and Simson, 1950; O'Brien, 1980). This study attempted to add to that research by linking cinematic knowledge, literary knowledge, and affective response. Earlier research was tangential to this study; this research employed natural settings and the Gestalt approach in an attempt to discover new relationships.

Affective Responses

Film viewers understood more than videotape viewers. However, it did not follow that those who understood the film or videotape to the greater extent were also those who were most affected. A majority of film viewers (85%) and videotape viewers (62%) reported understanding the narrative.

The data from the attitudinal survey revealed that many more students understood the film or videotape than were affected by it.

These data suggested that the high levels of familiarity with film, videotape, and television did not create a high level of understanding of the images viewed. These data also suggested that great familiarity with film study, television study, or photographic processes did not help create greater understanding nor attitudinal change.

Film students attended more, talked less, and revealed more involvement during their viewing. In discussion, the film students were perhaps more descriptive in their discussion of favorite scenes, and in the survey, film students revealed more change in mood, and more liking for the film. As substantiated by earlier research (Allen, 1969), the film was more affective than the videotape.

Recommendations

This study attempted to investigate a comparison between film and videotape in the classroom, and to consider the aesthetic and literary of learning. Educators may need to provide increase training in cinematic skills. Also, students may need to be given opportunities for individual response, as in the interviews, in order to overcome peer

The data reported here suggested some areas for further study. Future research could focus on participants, film elements, viewing habits, viewing conditions, and other areas.

Information about the individual participants could provide further details related to their understanding of the visual message. The data was not differentiated by sex, and the observers noted that sex and age differientiation would have been helpful and interesting. Also, further identification of individual students' abilities such as reading level, photography skills, or film study could explicate more clearly student familiarity with film and videotape.

Students' true understanding of cinematic elements was not established. Future research needs to identify separate film elements and provide individual visual tests of student comprehension. Earlier research (Hoban and van Ormer, 1951) delineated these elements, but students today have viewed thousands of hours of television and may react differently.

Investigation of student responses suggested some interesting links relating viewing habits and media familiarity to literary and affective responses. Individual student inventories of viewing habits, training, and abilities could yield causal relationships between experience and responses.

The difference in viewing behaviors of film and videotape viewers suggested some unexplored questions dealing with viewing habits and conventions. The difference between film and television viewing conditions may be creating changes in viewing habits, which could be investigated further.

All of these elements are areas for future research. Future research should provide some answers to the film/videotape controversy and to the growing inquiry into visual literacy. The "exploration of ideas, analysis, synthesis, interpretation, actual classroom behavior, and creative expression: (Lacey, 1972) should all be encouraged through future research.

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DEVELOPMENT OF AN INDEX OF COMPUTER ANXIETY

by

Daniel J. Rohner
Instructional Computing Consultant
Northern Trails Area Education Agency
Box M
Clear Lake, Iowa 50428

and

Michael R. Simonson, Ph.D.
Professor of Secondary Education
Instructional Resources Center
N-31 Quad
Iowa State University
Ames, Iowa 50011

IR009579

STATEMENT OF PROBLEM

Computer technology has become an integral part of our daily living. Simple processes such as cashing a check or making a phone call that once relied on the services of a bank teller or an operator now are routinely handled by a computer. According to Levien (1972), "we are now experiencing the transition from an era in which the computer was an esoteric tool to one in which the computer will be an everyday necessity. (In addition), the growth of computers has exceeded the most optimistic estimates" (p. 1).

One field that has not quickly accepted the services of the computer is education (Eastwood, 1978; Finley, 1970; Roberts, 1978). Like some other forms of educational technology, computers have met with resistance to being included in the instructional process (Anastasio, 1972; Cooper, 1978; Kritek, 1976). Resistance to innovation and change has been a continual problem throughout the history of formal education. According to the Carnegie Commission (1972), there have been four revolutions in education, each meeting with less than immediate and total acceptance. The first revolution occurred when the responsibility of teaching children went to someone other than their parents. The second came with the written word. A third revolution was experienced when printing made books available on a wide scale. And today, with current technological advancements, we are in the midst of a fourth revolution (Carnegie Commission, 1972).

At each of these four major periods of change, there was considerable resistance and rejection by many parents and educators. There continues to be resistance to various components of the fourth revolution, including the computer. This resistance has been attributed to rejection through ignorance, fear of the unknown, laziness, lack of incentives, rejection through experience, etc. (Eichholz and Rogers, 1964). In the case of the computer, one reason for the resistance is what can be called, "Computer Anxiety" (CA). CA can be described as the mixture of fear, apprehension, and hope that people feel when planning to interact or when actually interacting with a computer. Because of this feeling, people who are computer anxious, when given the choice between using and not using a computer, often choose to not interact (Levien, et. a., 1972; Seidel and Rubin, 1977). Computer Anxiety among teachers is one factor that is inhibiting the potential benefits of computer technology in education.

By following the guidelines provided by the fundamentals of curriculum design, it is possible to solve the problem. No respectable superintendent would allow a new reading system implemented in the school district without first analyzing needs and resources, the advantages and disadvantages of the system, and support material. It would be just as intolerable to start a new program without giving teachers in-service. The same planning and preparation should be conducted for all new educational systems. Unfortunately, in the case of CAI, adequate preparation is often neglected. It seems that the leaders in some school districts and educational institutions are so excited about the prospect of what computers can do that they fail to follow the proper procedures that would insure a more positive experience.

One of the first activities of instructional design focuses on the assessment of needs and resources. This investigation will contribute to the assessment of needs phase of the instructional design. The project will involve the development of a measure that will provide an index of computer anxiety in prospective teachers. With a reasonably valid instrument, teacher CA can be assessed. Based on individual and group scores, decisions can be made as to what in-service experiences would be best for each teacher or group of teachers.

To develop such a measure, the term Computer Anxiety needs to be operationally defined (Simonson, 1979; Henderson, et al., 1978). Once it is defined, valid, reliable questionnaire items need to be developed to measure that construct. Third, an index or normative reference must be established that would indicate how "computer anxious" a person is relative to the others in the group. Additionally, this study will correlate the CA index for each subject to certain subject traits (sex, academic subject area, cerebral dominance, field independence/field dependence). A strong correlation to any particular trait would suggest further study and possible in-service treatment specifically designed for individuals with that characteristic.

In summary, the purpose of this project is to follow these steps:

1. Define Computer Anxiety
2. Develop CA instrument
3. Pilot CA instrument to obtain descriptive statistics
4. Administer CA instruments to subjects
5. Obtain sex, subject area, cerebral dominance, FD/FI data from subjects
6. Correlate CA with subject traits

Four Research Questions

The main goal of the project is to develop a reliable, valid measure of CA.

Using the CA index, the researcher, through correlation coefficients, will attempt to answer these four questions:

1. Is there a significant relationship (p .05) between CA and Sex?
2. Is there a significant relationship (p .05) between CA and Subject Area?
3. Is there a significant relationship (p .05) between CA and Cerebral Dominance?
4. Is there a significant relationship (p .05) between CA and FD/FI?

REVIEW OF LITERATURE

Innovation

For centuries the Yir Yoront people of Australia lived in a stable culture. The tools they used for food production were fashioned from stone. To have an ax was a symbol of power and dominance. Only men could own an ax. If a woman or child needed a tool, they were required to borrow one from a man. This lending-borrowing practice was a traditional, well-understood ritual. In the early 1900s, Christian missionaries discovered this "primitive culture" and brought to the Yir Yoront people the wonders of the modern world, including steel axes. Being the generous people that they were, the missionaries distributed the axes to not only the men, but to the women and children as well. With that, there was no longer a need for the women to borrow tools from the men and a long cherished (at least by the men), tradition was destroyed. Providing food with stone tools had been a full-time job for the Yir Yoront men. Suddenly, with steel tools, there was time in the day for other things. The missionaries envisioned rapid advancements in the society. But the Yir Yoront men knew only two activities, work and sleep. So when the work with the new tools was done, the rest of the day was spent in slumber (Blumenfeld, et al., 1978).

The Yir Yoront men reacted in a way not unlike some teachers' reactions to innovation. Educational innovators often act similarly to the missionaries. The literature of educational innovation speaks consistently of well-meaning "missionaries" who introduce new products or methods that will be "salvation" in the classroom. What is often found is that the innovation is so different to the classroom tradition that it is rejected, or if accepted, disrupts the familiar traditions of the classroom and is utilized improperly.

When considering innovation that would require change, it would be wise to consider responses that teachers have made in the past to changes that have occurred. Several researchers have found that teachers resist change for a number of reasons. Below are some suggested reasons for teacher resistance to innovation.

1. Eastwood (1978) and Finley (1970) suggested that teachers fear they will lose their jobs. This fear stemmed from the concern that a machine would be able to teach more efficiently and that teaching staffs would be cut.
2. The lack of rewards for innovation was a barrier to change (Cooper, 1978; Eastwood, 1978).
3. The general need of teachers for independence and the need to be in the "spotlight" was reported to inhibit any new product or program that might reduce either one (Levien, 1972).
4. The fact that teachers need to assume new roles with each innovation has caused role overload. A person can only assume a finite number of roles . . . as new roles were acquired, old roles were modified (Kritek, 1976; Roberts, 1978).
5. Pincus (1974) suggested that many new teachers simply would not accept the responsibility to make appropriate changes in behavior patterns needed to accept innovation.

6. Eastwood (1978) stated that teachers feel that new technology would have a dehumanizing effect on students and teachers. While the academic portion of the curriculum might be enhanced, the importance of the teacher as a role model, counselor, or friend might be neglected. Teachers resisted even the experimenting with innovation in the schools because they thought it may have a detrimental effect on students.
7. Even if teachers accepted an innovation, resources in the form of manpower and software were often found to be insufficient or totally lacking (Eastwood, 1978; Roberts, 1978).
8. Kritek (1976), in a review of forty-four case studies, observed that in many situations where innovative instructional systems were supposedly implemented, the system, in practice, was very different from what was originally adopted. It appeared that innovation was almost never adopted as a whole, but "transformed" as it was incorporated. Kritek referred to this as the "natural law of program survival." The parts of the new system that were consistent with the status quo were emphasized and the parts that challenged tradition were ignored. Eastwood (1978) supported this finding by reporting a quote credited to the Association for Supervision and Curriculum Development (ASCD). According to ASCD, the educational system has a tremendous ability to absorb change while not changing at all.

In summary, there are a multitude of barriers to innovation in the classroom, educational, economic, institutional, and legal, but they are

". . .no more critical than barriers due to the attitudes and traditions that have grown up about education" (Eastwood, 1978, p. 20).

Anxiety

Teacher anxiety has long been a topic of concern for educators. In 1933, 11 percent of the teachers responding to a nationwide questionnaire had suffered nervous breakdowns. An additional 17 percent reported being "unusually nervous." In 1938, the National Education Association reported that 37.5 percent of 5,150 teachers studied saw themselves as being "seriously worried and nervous." By 1967, the percentage of those teachers who felt they were under "moderate or considerable strain" had climbed to 78 percent (Coats, 1976). As reported previously, and expanded upon below, the emotional state of teachers can affect the performance of students. Thus, this growing problem could have serious effects on the welfare of the students of these teachers under strain, as well as the welfare of the teachers themselves (Doyal and Forsyth, 1973).

The responses of highly anxious teachers have been correlated with many undesirable classroom situations. Youngs (1978) reported that highly anxious teachers were less likely to administer positive reinforcement and had more disruptive students than nonanxious teachers. Anxious teachers had a strong desire to remove themselves from an uncomfortable situation and any future risk-taking situations. While in stressful situations, anxious teachers reported negative emotions (inferiority, uselessness, loneliness, betrayal), which lead to increased anxiety. In an extensive review of anxiety research, Keavney and Sinclair (1978) concluded that teacher anxiety was consistently correlated with low rapport with students, less verbal support, more hostile speech and behavior, increased dogmatism, and pupil anxiety. Teacher anxiety was negatively correlated with teacher warmth and pupil achievement.

Certain character traits have been associated with teacher anxiety. Females appeared to be more anxious than males, particularly toward mechanical devises (Finley, 1970; O'Toole, 1964; Thompson, 1963). This conclusion must be cautiously interpreted, particularly because of the dates when the research was conducted. Social conditions and biases at the time may have contributed to those results. The grade level at which a teacher works may also be associated with anxiety. In a study of 125 student teachers, elementary student teachers were found to be more anxious than secondary student teachers (Thompson, 1963).

Still another characteristic, "hemisphericity," has been associated with anxiety. Tucker, et al. (1978) studied the effects of stress on the processing capacity of the brain's right and left hemispheres in 80 college students. Tucker asked his subjects to perform tasks using visual information that was presented to them. The information that was presented to the left visual field and interpreted by the right hemisphere was processed equally well by the anxious and the control groups. However, highly anxious subjects made more errors when the information was presented to the right visual field and processed by the left hemisphere. It appeared that anxiety overloaded the processing capacity of the left hemisphere under high task demanding situations.

Innovation in education is seldom totally and immediately accepted. Resistance to change is attributed to a variety of reasons, including fear of automation, fear for job security, need for independence, role overload, laziness, the dehumanizing effect of technology, lack of supporting resources, and tradition.

Teacher Anxiety (TA) has been associated with the introduction and resistance of innovations. Many variables such as the classroom situation, teacher style of reinforcement, student achievement, student behavior, and teacher behavior have been successfully correlated with TA. While not strongly corroborated, there appears to be some indication that innovation can lead to TA which can lead to undesirable classroom situations. Learner characteristics including sex, teacher grade level, cerebral dominance, and field dependence have also been correlated with TA.

While there are various forms of resistance to educational innovation, there are also facilitators to change. Ready understanding of, perceived relevance of, and gathering a critical mass of advocates for a particular innovation will facilitate its implementation. Following general models of change also encourage the acceptance of new techniques. The computer is one form of educational innovation that has experienced the resistance described above. But while the computer has met with resistance in some areas, in other areas it has been accepted through the use of facilitators and models of change.

Hemisphericity, Field Dependence, sex, and teacher subject area can all be measured. In addition, a newly identified construct, Computer Anxiety (CA) can be measured through the use of an instrument developed according to the following steps:

1. Identify the construct
2. Find a measure

3. Design a measure
4. Conduct pilot study
5. Revise pilot study
6. Summarize and display results

Because of the possible relationship between TA, computers, subject characteristics, and various classroom situations, it would be wise to investigate these relationships.

METHODOLOGY

The Sample

The prospective teachers used in this investigation were enrolled in Secondary Education 301 (SECED 301), the introductory media course for undergraduate education majors at Iowa State University. The class is designed for juniors, but it is not uncommon to find sophomores, seniors, and sometimes, freshmen also enrolled. The course requires that students have taken a fundamentals of education course prior to enrolling in SECED 301.

Figure 1 is a summary of the distribution of the sample.

Sex

Number of subjects:	175
Males	47
Females	121
Missing Data	7
	175

Subject Area

Number of subjects:	175	
Child Development and Elementary Education		66
Home Economics (other than CD)		22
Science and Humanities		34
Education (other than El Ed)		17
Agriculture		19
Missing Data		17
		175

Figure 1. Demographics of the sample

Procedures

The main purpose of this study was to produce a valid and reliable index of Computer Anxiety (CA). Since one did not already exist, the researcher was forced to construct one. The literature on attitude test construction was reviewed and the suggestions of Henerson, et al. (1978) for attitude test development were followed.

The first step was to decide what kind of a measure the CA instrument would be. It was decided that the agreement scale (Likert type) format would be used because of its familiarity to subjects and ease of manipulating the resulting data. At the same time, it was decided to calculate an index from subject responses in order to have one score of CA that could be correlated to other subject characteristics.

The second step involved finding or generating statements to be used in the CA instrument.

Since attitudes have three components, affect, cognition, and behavior, the statements were arranged according to which component they referred. Of the initial 63 statements generated concerning computers in the classroom, 21 dealt with the cognitive component, 22 referred to the affective component, and 20 were related to behavior. The 63 statements were presented to an attitude reasearch expert who testified to their face validity, that is, they appeared to make statement about a person's knowledge, feeling, or behavior toward computers in an educational environment.

A pilot test was then conducted using 32 subjects in two summer classes of SECED 301.

After the scores were calculated, the students with the lowest five scores were selected as the "positive" group. The students with the five highest scores were selected as the "negative" group. The two groups were then compared in an item analysis to determine which statements had the most influence in causing the scores in the "positive" group to be low and the socres of the "negative" group to be high. From the item analysis, ten statements were selected as ones that tended to separate the two groups. Those ten statements were selected to compose the subsequent Computer Anxiety Index. The item analysis identified those statements that tend to make the negative responders "more" negative, and the positive responders "more" positive (Henerson, et al., 1978).

To discourage the subjects from establishing a "computer set" while responding to the ten statements about computers, 20 "distractor statements" were generated and randomly included with the ten "target statements" on the final questionnaire. To further protect against the respondents establishing a response set, the instrument was entitled "Educational Innovation Survey." The distractor statements referred to other recent forms of educational innovation such as new teaching methods and video tape. The intent was to convince the subjects they were responding to 30 statements on various innovations, not statements about computers. To obtain a reliability estimate for the CA index, the Cronbach Alpha method was used both during the pilot test and the main study. From the pilot test, the 10 target items yielded a reliability estimate of .88. The reliability estimate for the CA index in the main study was .86. Additional normative data for both the pilot test and the CA index in the main study are as follows:

	Pilot study	CA index in main study
# of subjects	31	175
Mean	31.9	31.8
Standard deviation	7.0	6.5
# not responding or missing data	1	3

A second goal of the study was to correlate the CA index with four respondent characteristics: sex, subject area in which the respondent was planning to teach, Field Dependence, and Hemisphericity. Data on the first two characteristics were obtained from class lists. The hemisphericity information was obtained from each subject through Form A of the Your Style of Learning and Thinking test (SOLAT) developed by E. Paul Torrance at the University of Georgia. SOLAT consists of 36 sets of three statements about memory and other mental processes. The respondent selects the statement of the three that most closely describes him/herself. In the triplets one statement describes a left cerebral process, one describes a right cerebral process, and the third describes a person who integrates the two hemispheres. After compiling each subject's responses, he/she was placed on a continuum that indicated subjects as being more right or left dominant according to where he/she was in relation to his/her peers. In other words, each subject received a "hemisphericity score" that would be correlated with CA. A low score (e.g., 56) meant that a student tended to be left hemispheric dominant. A higher score (e.g., 88) meant that a student tended to be right hemispheric dominant.

Next, 50 subjects were randomly selected to complete another measure one week after completing the CA and SOLAT instruments. These 50 subjects were administered the Group Embedded Figures Test (GEFT) as a measure of field dependence.

Information for all subjects in the sample included sex, subject area, CA index, and Hemisphericity score. The fifty subjects that completed the GEFT test had an additional score for that measure.

As mentioned, the CA index was of greatest concern. For each subject the CA index was correlated with their sex, subject area, and SOLAT score. The 50 subjects who had a GEFT score also had that score correlated with CA. From these correlations, conclusions were drawn and recommendations made as to the relationship between CA and those variables.

Summary of procedural steps

1. Operationally define Computer Anxiety
2. Select type of measure
3. Generate possible test items
4. Determine face validity of items selected
5. Conduct pilot study
6. Complete item analysis of pilot study
7. Calculate reliability estimate of pilot study
8. Select items for final instrument
9. Generate distractor statements
10. Obtain SOLAT and GEFT
11. Obtain information on subjects' sex and academic subject area
12. Administer final CA instrument
13. Administer SOLAT
14. Randomly select subjects for GEFT

15. Administer GEFT
16. Score and compile normative data for CA index, SOLAT and GEFT
17. Compare normative data for SOLAT and GEFT to standardized data available from the test publisher
18. Calculate reliability estimate of CA index
19. Correlate CA index with sex, subject area, Hemisphericity and Field Dependence
20. Draw conclusions
21. Make recommendations
22. End.

Results For Computer Anxiety Index (CAIN)

In the undergraduate and media (SECED 301) classes, 178 subjects responded to the Computer Anxiety (CA) instrument. Three subjects failed to complete the entire instrument. Those three subjects' scores were discarded before the results were compiled. As reported previously, Computer Anxiety and scores on the CA Index are directly related. That is, one would expect subjects with high scores to have a great deal of Computer Anxiety while those who score low would also be low in CA. Figure 2 summarizes the descriptive statistics for the CA Index. Figure 3 illustrates the results of cross tabulations of the CA Index with sex.

An estimate of reliability of CAIN was calculated through the Cronbach Alpha formula. A reliability estimate of r = .86 was obtained.

Results for Your Style of Learning and Thinking (SOLAT)

The Your Style of Learning and Thinking (SOLAT) test was completed by 168 of the possible 175 subjects who correctly completed the CAIN. SOLAT was a measure of hemisphericity. A low score on the test indicated left hemispheric dominance. A high score indicated right hemispheric dominance. Two of those 168 subjects' scores were discarded because of missing data in the responses. One-hundred sixty-six valid scores remained for SOLAT. The scores for SOLAT in this study were tabulated somewhat differently than the scores used for the normative data. Rather than reporting total scores for individuals, mean scores were given for the number of questions that were answered with a right hemispheric response, an integrated response, and a left hemispheric response. For example, in the norm group, each individual, on the average answered 9.2 questions with a right hemispheric response, 8.4 questions that would be attributed to the left hemisphere, and 18.4 questions with an integrated response. Based on the points given to each response in this study (left = 1, integrated = 2, right = 3), the average score from the normative data would be 71.2. Because of the way the points were assigned, a low score would indicate a tendency for left hemispheric dominance and a high score would indicate a tendency for right hemispheric dominance.

N	175
Lowest Possible Score	10
Lowest Actual Score	12
Highest Possible Score	50
Highest Actual Score	49
Range	31
Mean	31.8
Median	31.3
Mode	31
Standard Deviation	6.5

Note: Low Score = Low Computer Anxiety
High Score = Higher Computer Anxiety

Figure 2. Computer Anxiety Index (CAIN) descriptive statistics

	Male	Female
N	47	121
Minimum Score	20	12
Maximum Score	49	45
Range	27	33
Mean	31.7	31.8
Standard Deviation	7.1	6.2

Number Missing (not on class list so sex could not be determined) = 7

Figure 3. Tabulation of Computer Anxiety Index by sex.

Figures 4 and 5 show the cross tabulation data for sex and subject area.

	Male	Female
N	42	117
Minimum Score	61	56
Maximum Score	81	88
Range	20	32
Mean	72.3	72.7
Standard Deviation	5.7	6.2

Number Missing (not on class list so sex could not be determined) = 7

Figure 4. Tabulation of SOLAT (hemisphericity) by sex.

	ElEd CD	HED w/o CD	Sci & Hum	Ed w/o ElEd	Ag
N	63	22	34	16	16
Minimum Score	56	62	61	67	64
Maximum Score	85	83	88	81	88
Range	29	21	27	14	24
Mean	72.1	71.2	73.0	74.6	74.5
Standard Deviation	5.6	5.7	7.1	5.2	6.0

Number Missing (not on class list so subject area could not be determined) = 15.

Key:

EdEd/CD = Elementary Education, Child Development

HEC w/o CD = College of Home Economics without Child Development majors

Sci & Hum = College of Sciences and Humanities

Ed w/o ElEd = College of Education without Elementary Education majors

Ag = College of Agriculture

Figure 5. Tabulation of SOLAT (hemisphericity) by college major of subjects.

Pearson Correlations Between Variables

Pearson Correlation Coefficients were generated between the Computer Anxiety Index (CAIN) and Sex, SOLAT, and GEFT. These coefficients, sample sizes, and level of significance are reported in Figure 6.

Computer Anxiety and College Major

A one-way analysis of variance was completed to compare the CA index with college major. Figure 7 summarizes these data. The results showed no significant difference between the mean scores of any of the groups of subjects.

T-Test of Computer Anxiety on SOLAT

The table of correlation coefficients did not reveal any relationship at the .05 level of significance. It did indicate that there may be a possible relationship between CA and hemisphericity. The correlation coefficient was calculated as -.1215 with a probability level of .059. To study this further, the CA scores of subjects were placed into 5 groups. Scores that were greater than one standard deviation below the mean were placed in the low (low computer anxiety) group. Scores that were greater than one standard deviation above the mean were placed in the high (high computer anxiety) group. The other scores were placed in three groups of 1/2 to 1 standard deviation below the mean, within 1/2 standard deviation of the mean, and 1/2 to 1 standard deviation above the mean.

Computer Anxiety Correlated With:	Correlation Coefficient	Number of Cases	Level of Significance
Sex	.009	168	.454
SOLAT (hemisphericity)	-.122	166	.059
GEFT (field dependence)	-.100	47	.251

Figure 6. Pearson Correlation Coefficients

	Degrees of Freedom	Sum of Squares	Mean Square	F Ratio	F Probability
Between groups	4	257.13	64.628		
Within groups	153	6244.76	40.82	1.58	.18
Total	157	6501.89			

Figure 7. Analysis of variance - Computer Anxiety Index by college major.

A t-test was calculated between the low CA group and the high CA group on the SOLAT variable. Figure 8 summarizes this calculation. The t-test between high and low Computer Anxiety failed to demonstrate a significant difference between the two groups for the hemisphericity variable.

SUMMARY

The results of this study reveal a fairly normal distribution for the variables of Computer Anxiety, hemisphericity, and field dependence. No statistically significant relationship was found between Computer Anxiety and sex, college major, hemisphericity, or field dependence.

A possible trend was revealed between Computer Anxiety and hemisphericity. The negative correlation suggested that right hemispheric dominant subjects are slightly more computer anxious than left hemispheric dominant subjects. A post hoc analysis failed to reveal a significant relationship between these two variables.

The Computer Anxiety Index appeared to be a reliable measurement. Using the standard of r = .70 as being a respectable reliability estimate for an attitude measurement, the reliability estimates of r = .88 for the pilot test and r = .86 for the main study are quite encouraging.

	N	Mean	Standard Deviation	t-value
Low CA	22	74.1	5.3	0.89
High CA	30	72.6	6.6	

Figure 8. T-test - low/high Computer Anxiety on SOLAT.

DISCUSSION OF RESULTS

The idea for this study originated with the researcher's past experiences with teachers who exhibited resistance to educational innovations. New techniques or devices have almost always met some level of resistance from educators. The computer is one example of a powerful instructional tool that has met this resistance (Anastasio, 1972; Blumenfeld, et al., 1978). There are a variety of reasons to explain why the computer has not been widely accepted. Computer Anxiety (CA) may be one source of resistance.

In order to facilitate the acceptance of computers in the classroom, the researcher applied the principles of instructional design (Gagne and Briggs, 1979). One of the first steps in any well-designed instructional system is the assessment of needs. The intent of this research was to assess the needs of prospective teachers by creating a measure of Computer Anxiety that could be used to determine the extent of this problem.

Anxiety seems to be logically associated with resistance. Research has indicated that there is a great deal of anxiety among teachers from preservice to the most experienced (Coates and Thoresen, 1976; Keavney and Sinclair, 1978; Travers, et al., 1952; Youngs, 1978). The research cited related anxiety to sex (Finley, 1970; O'Toole, 1964; Thompson, 1963), teacher grade level (Thompson, 1963), and cognitive style (Tucker, et al., 1978). Because of these relationships, for this study, data on these characteristics were gathered from prospective teachers and compared to CA scores. None of these characteristics had a statistically significant relation to any other variable.

Hemisphericity Relationship to Computer Anxiety

One relationship suggested by the literature was between anxiety and hemisphericity. It was reported that those subjects who were left hemispheric cominant tended to be more adversely affected by anxiety than other subjects (Tucker, et al., 1978). The hemisphericity variable as measured by the Your Style of Learning and Thinking (SOLAT) test (Torrance, et al., 1977) was correlated with the score from the Computer Anxiety Index. The SOLAT scores were also tabulated by sex and college major.

The tabulation of SOLAT by sex revealed a slightly lower mean for males than females. While the relationship is not statistically significant, it is consistent with the general agreement that more males tend to be left hemispheric dominant than females. An analysis of variance of SOLAT by college major found no statistically significant difference between the groups. This was also expected.

The correlation of SOLAT with CAIN prompted some additional analysis. The correlation of -.1215 at the .059 level of significance suggested that there was a tendency for the left hemispheric dominant subjects to have more computer anxiety than right hemispheric dominant subjects. The most highly computer anxious subjects were compared to the subjects with the lowest CA scores on the hemisphericity variable. The post hoc t-test for the high and low groups failed to show a statistically significant difference. However, the correlations between these two variables indicated that there might be a trend between CA and hemisphericity. Because of this possible trend, the conclusion drawn about these two variables was that while this study did not consistently show a strong relationship between CA and hemisphericity, there was sifficient evidence to warrant additional study of that possible relationship in the future.

The Computer Anxiety Index

From the results of this study, several comments about the CA Index can be made. It is gratifying to see the high reliability estimate for both the pilot test (r = .88) and the main study (r = .86). These data suggest that the CA Index is in fact a consistent measure. The remaining concern is the question of validity. Is the CA Index actually measuring Computer Anxiety?

With confidence, it can be said that for this group of subjects the instrument is not influenced by subject sex, college major, or field dependence. The instrument may have some relationship to hemisphericity, but with the low correlation coefficient between these two variable scores, it would be safe to say that the entire instrument is not an effective measure of hemisphericity.

Few would argue with the previous statements about what the CA Index does not measure. Most would probably agree that it is measuring something. The reliability of the instrument would support that. But there most likely would be some question as to whether the construct that is measured truly is Computer Anxiety.

The ten statements that made up the final CA instrument referred to future use of and past experiences with computers. The obvious questions similar to "I feel anxiety about using computers" were eliminated during the pilot study because they failed to discriminate. Because of this question of validity, several educators who were identified as being highly computer anxious completed the CA instrument in a post hoc analysis. The scores from these subjects were variable. Some of the highly computer anxious subjects did indeed receive high scores on the CA Index. Other scores, however, were within one or two points of 15. A score of 15 would indicate a generally neutral feeling. None of these highly anxious subjects' scores was below 10. In informal interviews with these computer anxious subjects and computer professionals, it appears the instrument might be measuring a construct that could be called "intent to use."

If the CA instrument is reliably measuring "intent to use," and it appears it is, it could be used without much revision to measure just that.

A reliable measure of this type could provide curriculum planners valuable information on what kind of training individual teachers or groups of teachers require in schools targeted for implementation of computer assisted instruction (CAI). Subjects whose scores indicate a favorable intent to use computers would receive different training from those whose scores indicate they do not intend to use the computer. Perhaps those teachers who do intend to use CAI would be used to introduce and train those who do not.

Through the post hoc analysis, it appears that computer anxiety and the intent to use computers have some similarities. Intuitively, one would expect them to be related. For the curriculum designer in schools, the critical problem is to make the most effective use of the capabilities of computer technology to support instruction. If the Computer Anxiety Index can be used to reliably measure a specific teacher's intent to use, the results from the test can be quite valuable.

The Computer Anxiety Index probably is measuring anxiety as one factor that inhibits the intent to use. It probably is also measuring some teachers' preferences for using other forms of instruction. But because it can be constructively used "as is."

Finally, even though Computer Anxiety and intent to use are quite similar, there still remains a distinct difference. "Anxiety" certainly is different from "personal preference." Because of this difference and because of the rapid growth of the effects of computers in education and all of society, the attempt to isolate CA from all other variables becomes increasingly important. The CA Index developed in this study can be used as a useful diagnostic tool, but in the future it could be replaced by at least two more specific, more powerful instruments. One future instrument could measure "preference for medium of instruction." The second instrument could measure Computer Anxiety in isolation. The effort to measure CA as an independent construct should be a continuing endeavor. It should not be confined to the pages of this document, nor end with the end of this research.

Conclusions

1. The CA Index is a reliable instrument.
2. The CA Index has no significant relationship to sex.
3. The CA Index has no significant relationship to college major.
4. The CA Index has no significant relationship to field dependence.
5. The CA Index might have a slight relationship to hemisphericity.
6. The CA Index might be used in its current form as a measure of intent to use computers in the classroom.
7. The intent to use computers is probably a combination of Computer Anxiety and personal preference.
8. In the future CA will become an even more critical problem.
9. The effort to isolate and reduce CA should continue.

SUMMARY

The main purpose of this research was to develop a measure of Computer Anxiety. The instrument, consisting of 10 target statements and 20 distractor statements, was administered during the fall of 1980 to 175 education students in the undergraduate media course at Iowa State University. The score from the 10 target items was correlated to sex, hemisphericity, and field dependence. An analysis of variance was calculated between the scores on the Computer Anxiety Index and the subject's college major. While no statistically significant relationships were found for any variable, there appeared to be a slight relationship between hemisphericity and Computer Anxiety. The Computer Anxiety Index reliability estimate was fairly high (r = .86) but the instrument may be a valid measurement of "intent to use" the computer in the classroom which included Computer Anxiety. It was stated that the need to identify and reduce Computer Anxiety will become increasingly important in the future. The recommendation was made that research in Computer Anxiety should continue.

APPENDIX 1

YOUR STYLE OF LEARNING AND THINKING

Form A

INSTRUCTIONS: On the answer sheet provided, describe your style of learning and thinking by blackening the appropriate blanks. Try to describe your own strengths and preferences as accurately as possible.

1. (a) not good at remembering faces
   (b) not good at remembering names
   (c) equally good at remembering names and faces.

2. (a) respond best to verbal instructions
   (b) respond best to visual and kinesthetic instructions
   (c) equally responsive to verbal and visual/kinesthetic instructions

3. (a) able to express feelings and emotions freely
   (b) controlled in expression of feelings and emotions
   (c) inhibited in expression of feelings and emotions

4. (a) playful and loose in experimenting (in cooking, art, athletics, writing, research, teaching, etc.)
   (b) systematic and controlled in experimenting
   (c) equal preference for playful/loose and systematic/controlled ways of experimenting

5. (a) preference for dealing with one problem or variable at a time
   (b) preference for considering several problems or variables simultaneously
   (c) equal preference for sequential or simultaneous consideration of problems/variables.

6. (a) preference for multiple-choice tests
   (b) preference for open-ended tests which have no single "right" answer.
   (c) equal preference for multiple-choice and open-ended tests.

7. (a) good at interpreting body language
   (b) poor at interpreting body language; dependent upon what people say
   (c) equally good at interpreting body language and verbal expression

---

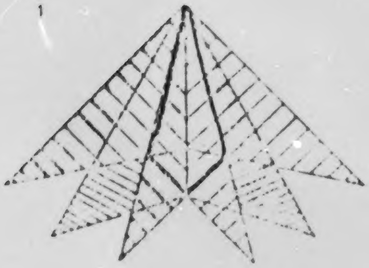
Georgia Studies of Creative Behavior
Department of Educational Psychology
University of Georgia
December, 1975

APPENDIX 2

SAMPLE PAGE - GROUP EMBEDDED FIGURES TEST

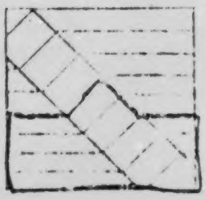
THIRD SECTION

1



Find Simple Form "F"

2



Find Simple Form "G"

APPENDIX 3

COMPUTER ANXIETY INDEX (EDUCATIONAL INNOVATION SURVEY)

EDUCATIONAL INNNOVATION

SURVEY

Please fill in your Social Security Number in the Identification Number section of your answer sheet. Then record your answers using the five point scale below.

A/1 = Strongly Agree
B/2 = Agree
C/3 = Undecided/No Opinion/Don't Know
D/4 = Disagree
E/5 = Strongly Disagree

EDUCATIONAL INNOVATION SURVEY

1. Having a computer in my room would improve my instruction.

2. I can think of some great ways to use the computer for teaching in my subject area.

3. If a student wanted to do a project for my class that involved recording a video tape, I would strongly encourage him/her to do it.

4. My subject area is not appropriate for using the computer.

5. I worry about the bad consequences of putting television in schools.

6. I believe innovation will help keep alive what is best in education.

7. I believe that more money should be spend on television equipment in schools.

8. When there is a staff of well prepared teachers in a school, films are not necessary.

9. Any teacher should be able to make use of photography in the classroom.

10. I don't plan to get involved in educational innovation.

11. Given the choice between teaching a subject through a traditional method or on a computer program, I would probably choose the traditional method.

12. I believe film projectors are too complicated for the average teacher to run.

13. Photography in schools contributes to a sound education.

14. A computer in my room would reduce discipline problems.

15. My use of computers has been very limited.

16. Films detract from the quality of instruction.

17. If there is a computer in my classroom, I will suggest it be placed in another room where it could be put to better use.

18. Teachers should be willing to give any new teaching method a try.

19. If there were no overhead projectors in my school, I would request that some be obtained.

20. I believe that filmstrips have been used successfully in many schools.

21. Television can be used for instruction in many subject areas.

22. I look forward to the time when computers are in all classrooms.

23. A teacher should not be expected to accept new media in the classroom.

24. If available, I would choose films over other forms of instruction for some of my teaching.

25. I doubt if I will use the computer in my teaching.

26. I think the taxpayers would see a record player in my classroom as a waste of their money.

27. I believe that, in general, non-print media, (films, video tapes, cassettes, etc.) are too expensive for schools to buy.

28. My undergraduate coursework has made me knowledgable of television in schools.

29. Few schools have successfully used non-print media in instruction.

30. I am not prepared to make use of the computer in my teaching.

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TITLE: Persuasive Films: Techniques Used to Change Attitudes

AUTHOR: Michael R. Simonson, Associate Professor of Secondary Education
Instructional Resources Center
N31 Quadrangle North
College of Education
Iowa State University
Ames, Iowa 50011
(515) 294-6840

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PERSUASIVE FILMS: TECHNIQUES USED TO CHANGE ATTITUDES

by

Michael Simonson
Iowa State University

Entertainment, enlightenment and persuasion are the primary reasons films are produced (Rose, 1963). In education, the training film has been a popular and useful tool of the teacher since World War II when millions of G.I.s were taught by film such topics as the fundamentals of personal hygeine, the functioning of the M-1 rifle, or the procedures for bracketing with mortar fire. Similarly, ever since Gone With the Wind, the Saturday matinee has been one of the major entertainment activities of millions. However, the history, impact and place in education of the persuasive film has been a little less obvious.

As early as 1931, Thurstone was able to demonstrate the influence of film on the attitudes of children. In this landmark study, it was found that two films depicting Chinese either favorably or unfavorably were capable of producing attitude changes either in a positive or negative direction, depending on the intent of the film. Since Thurstone, attitude change and persuasion have been the focus of many, if intermittent, film based research studies.

Attitude and persuasion have also been found to be related to learning. The perceptions that people have about a concept have been found to have some impact on how much they know, and are likely to learn, about a given subject (Levy, 1973; Fenneman, 1973; Simonson & Bullard, 1970; Greenwald, 1966; 1965; for example). While it would be wrong to ascribe a cause and effect relationship between liking and learning, there most certainly is some link between these two concepts. If students are excited about a topic, and "like" it, they will probably learn more about it than if they find it uninteresting, boring, or "no-fun". Films that persuade have a very important place in education. They can be used to convince students of the need to study science, of the importance of accepting individuals from other cultures, of the need to practice minimum tillage in order to prevent soil erosion, or of the possible health problems they may encounter if they smoke. Much of what we do in education directly involves persuading. Many of the films produced and used every year deal with topics such as these.

Fleming and Levie (1978) have provided additional reasons why it is important to be interested in the attitudes of students. First, most teachers would agree that there are cases when it is legitimate, and important, to urge learners to accept the truth of certain ideas. In other words, to promote an attitudinal position. Second, as stated above, that while the relationship between attitudes and learning is unclear it seems to be common sense that students are more likely to remember information, seek new ideas, and continue studying when they react favorably to an instructional method and certain content areas. Last, the instructional developer should be aware of procedures that are likely to influence attitudes in one direction or another so that bias can be reduced when inappropriate.

However, little is known about films that persuade or advocate some attitudinal position. An exhaustive review of the literature dealing with the relationship between attitudes and instructional films (Simonson, 1978; 1979a; 1979b) stated that there was little definitive information available in the literature concerning the specific procedures used in persuasive films to change people's attitudes. In other words, it has been confirmed that educational films can persuade viewers to agree with certain ideas, however, the techniques used by film-makers in the production of persuasive motion pictures that have direct impact on attitudes have not been systematically identified, examined, and categorized. There has been no comprehensive comparison between what film-makers do when persuasion is their goal, and what researchers tell us are the procedures for persuading.

One notable exception to this was the work reported by Levonian (1960, 1962, 1963) where the procedures used in the production of a film on India were described. Levonian administered a questionnaire to the film's target audience and then systematically analyzed the responses to this instrument in order to develop the motion picture's script. Levonian's film was successful in producing the desired attitude changes in the target audience. In other words, Levonian identified a specific technique based on research and applied it to the planning of a successful persuasive film. Certainly, other media researchers and motion picture experts have generated information designed to assist future producers in developing films that persuade. However, the procedures actually used by directors in their films have not been comprehensively analyzed and compared to the attitude change procedures outlined in the psychological literature (Insko, 1969).

Attitude Defined

Attitude has been a dificult concept to adequately define, primarily because it has been defined by so many, but also because of its many lay uses and connotations. One of the earliest definitions of attitude was proposed by Thomas and Znaniecki (1918). They defined attitude as:

> *A mental and neural state of readiness, organized through experience, exerting a directive or dynamic influence upon the individual's response to all objects and situations with which it is related (Thomas and Znaniecki, 1918).*

In other words, while attitudes are latent and not directly observable in themselves, they do act to organize, or to provide direction to, actions and behaviors that are observable. Also, attitudes vary in direction, either positive or negative; in degree, the amount of positiveness or negativeness;

and in intensity, the amount of commitment with which a position is held (Fleming and Levie, 1978).

Additionally, attitudes have three components: affective, cognitive, and behavioral (Zimbardo and Ebbeson, 1970). The affective component is said to consist of a person's evaluation of, liking of, or emotional response to some object or person. The cognitive component is conceptualized as a person's beliefs about, or factual knowledge of, the object or person. The behavioral component involves the person's overt behavior directed toward the object or person.

A persuasive film, then, is one designed with attitude formation and change as its primary purpose. While most films have a persuasive element, a persuasive film is defined as one where attitude development is the single most important goal of the film, and where entertainment or enlightment are included only to contribute to the ultimate goal of persuasion.

Purpose of the Study

Once there is agreement that persuasive films play an important role in education it is important to understand, among several other things, how these films are planned and produced, and what makes it possible for a film to persuade a viewer to accept an attitudinal position. Alfred Hitchcock is supposed to have once remarked to an executive producer that he never looked at motion pictures, to which the producer replied, "But where do you get all your ideas then?" (Rose, 1963).

"How they did it," in a film is a comment heard in many film production conferences. The techniques used by one film-maker in a successful film are often used as a model for similar films. Film-makers often produce films by formula. Many times they do not even realize what that formula really is (Rose, 1963). Most often, film-makers decide on, or are hired to present, a position in a film. The film-maker then works backwards, planning the presentation so as to include, through emphasis and selection, all the ideas and techniques that would be most likely to elicit the desired reaction in the viewer. In other words, the desired attitude is identified, then the film-maker decides how to persuade the audience to accept this attitude as a consequence of viewing a film (Rose, 1963). Often film-makers will chose procedures for a new film based on what had been used in previous films.

The identification of the specific techniques used by the film-maker to accomplish this persuasive goal was the purpose of this study. In 1979, Simonson identified six guidelines that if included in the planning, production or use of mediated instruction would contribute to the development of desired attitudinal outcomes in learners. These guidelines were based on the results of over 100 research studies dealing with attitudes and media. Unfortunately, these guidelines are fairly general and do not specify many exact processes a film-maker or teacher might use when persuasion is the primary goal of filmed instruction.

Simonson's (1979) six guidelines, and a sample of the research studies that support them are: (Note: Refer to Simonson, 1979, for a more complete discussion).

Guideline #1: Learners react favorably to mediated instruction that is realistic, relevant to them, and technically stimulating. (Levonian, 1960; 1962; 1963; Seiler, 1971; Klapper, 1958; Croft, et.al., 1969; Donaldson, 1976; Booth and Miller, 1974; Winn and Everett, 1978; Ganschow, 1970)

Guideline #2: Learners are persuaded, and react favorably, when mediated instruction includes the presentation of new information about the topic.

(Jouko, 1972; Knowlton and Hawes, 1962; Peterson and Thurstone, 1933; Levonian, 1960, 1962, 1963)

Guideline #3: Learners are positively affected when persuasive messages are presented in as credible a manner as possible.
(Kishler, 1950; Seiler, 1971; O'Brien, 1973)

Guideline #4: Learners who are involved in the planning, production, or delivery of mediated instruction are likely to react favorably to the instructional activity and to the message delivered.
(Erickson, 1956; Coldevin, 1975; Simonson, 1977; Goldman, 1969)

Guideline #5: Learners who participate in postinstruction discussions and critiques are likely to develop favorable attitudes toward delivery method and content.
(Allison, 1966; Fay, 1974; Domyahn, 1972)

Guideline #6: Learners who experience a purposeful emotional involvement or arousal during instruction are likely to change their attitudes in the direction advocated in the mediated message.
(Janis and Feshbach, 1953; Rogers, 1973; Miller, 1969)

The purpose of this study was to partially validate these research generated guidelines and to identify lists of specific techniques used by film-makers in their persuasive films that directly relate to these guidelines.

Procedures

In order to obtain information from film-makers about persuasive films a Film-Makers Survey (FMS) was developed. A pilot version of the FMS was sent to a small sample of film-makers and a revision based on their comments and suggestions was developed. This final version of the FMS had two parts. Part I dealt with the film-makers' background and experience. Part II asked the film-maker to rate, discuss or evaluate techniques used in persuasive film-making. Each item in Part II of the FMS was directly related to one of the six design guidelines identified by Simonson (1979), or to one of the three components of attitude discussed by Zimbardo and Ebbeson (1970).

One hundred fifty film-makers listed in the 1980 Council on International Non-Theatrical Events (CINE) catalog were sent a copy of the FMS with a cover letter explaining the purpose of this study. These film-makers were sampled because their films were listed in the CINE catalog as Golden Eagle Award winners, and the accompanying descriptions of their films seemed to indicate that their motion pictures were persuasive in intent. A random selection of film-makers was not considered necessary because of the descriptive nature of this study. Included with the questionnaire and cover letter was a stamped, addressed, return envelope. No follow-ups to film-makers who failed to return the questionnaire were attempted.

RESULTS

(See Appendix I for complete FMS results)

Fifty one questionnaires were returned, for a response rate of thirty four percent. This fairly small percentage of returns was expected because no follow ups to non-responders were attempted. Results from the questionnaire that were returned were considered representative for the purposes of a descriptive study such as this one.

Background Information on the Responding Film-Makers

All fifty one of the film makers who were surveyed indicated that producing motion pictures was their primary method of employment. The average length of time respondents had been employed as film-makers was slightly more than 18 years. The range of years of employment was one year to forty years. Ninety one percent of the respondents were males. The average age was forty six. Ages ranged from twenty five for the youngest respondent to sixty eight for the oldest.

The average number of films produced by each film-maker was approximately 142. The range of number of films produced was from one to two thousand. The average number of persuasive films produced was twenty nine (Range = 1 to 200). For the persuasive films, the average film length was 18.3 minutes. The shortest persuasive film was reported to be two minutes. The longest was 30 minutes. There were a large number of twenty-eight minute films reported, probably because this was a popular length for films that were to be broadcast on television. Film-makers reported working in production companies with an average of eleven employees. The smallest company was a one-person free lance operation. The largest employed thirty five.

Thirty seven percent of the film-makers reported that they had no formal school training in film-making, only on-the-job training. Sixteen percent had some college. Twenty-one percent had bachelors degrees. Twenty-one percent had masters degrees or more, and five percent reported that they had attended a trade school. Only nine percent reported having any formal training in producing persuasive films. A large number of colleges and universities were mentioned by the respondents when they were asked to indicate what school they attended. The only institutions mentioned more than once were Columbia, Harvard, Iowa, City University of New York, UCLA, and USC.

The definition of a persuasive film used for this study was considered appropriate by seventy eight percent of the film-makers who answered the FMS. Almost without exception those who did not like the definition thought that it was too narrow and should be expanded to include broadcast, non-educational uses of films. (The definition used for this study was: A persuasive film is a training or educational film that has influencing, persuading or changing of attitudes as its primary purpose.)

Most respondents thought that the market for persuasive films would increase in the future (73%), and that about 40% of the educational film market was for films that persuade rather than inform. The average cost of a 10 minute persuasive film was estimated at $29,000 or $2900 per minute. (Range = $13,000-$65,000 per 10 minute film). This price was estimated as being only slightly higher than for an informative film of the same length.

Persuasive Film Production Techniques

One of the major goals of this study was to determine how film-makers would go about producing a film when persuasion was their goal. Film-makers responding to the FMS considered persuasive films to be planned and produced a little, to somewhat, differently than other educational films. One major difference was the importance of a pre-script writing target audience assessment that most film-makers considered critical to the success of their persuasive films. Technical quality of persuasive films was considered important, but only slightly more so than for any film. The "outs" ratio for persuasive motion pictures was estimated at being only slightly greater than for informative films.

In order to determine the production techniques that were considered most effective for persuasive films, several groupings of procedures were presented in the FMS for the film-makers to rate. The results of this rating process follows.

I. WHEN COMPARING PERSUASIVE FILMS TO OTHER EDUCATIONAL FILMS HOW IMPORTANT IS IT TO:

Rank

most important

1. use motion rather than static actors, objects, or graphics
2. use believable, realistic scenes, events, and actors rather than abstract ones
3. present new information on the topic
4. use an arousing, or dramatic musical score
5. use many rather than few scenes
6. produce a shorter rather than longer film
7. use color rather than black and white

least important

II. HOW WOULD YOU RATE THE FOLLOWING TECHNIQUES IN TERMS OF THEIR LIKELIHOOD OF INFLUENCING YOUR AUDIENCE?

Rank

most effective

1. conduct a target audience pre-assessment
2. hire professional actors rather than amateurs
3. present new information on the topic
4. have people in the film that are as similar to the target audience as possible
5. include a teacher's guide with the film to use during follow-up discussions
6. use testimonials from the "man on the street"
7. hire a big name star to promote your position
8. present inspirational messages
9. use title scenes to present verbal information visually
10. use graphs and charts for presenting facts

least effective

III. RATE THE FOLLOWING CHARACTERISTICS OF FILMS IN TERMS OF THEIR IMPORTANCE FOR USE IN A PERSUASIVE FILM.

Rank

effective techniques

1. attempt to "arouse" the audience intellectually, sexually, or emotionally
2. be as realistic in presenting the story as possible
3. make the film "fun" to watch
4. present facts
5. be as non-verbal as possible
6. use physically attractive actors and actresses
7. present both sides of an argument
8. use animation
9. use talking faces
10. scare the audience by presenting the dire consequences of not following the recommendations presented in the film.

not effective techniques

11. use many written scenes

When asked to rank three general statements concerning how important each was for a persuasive film, the film-makers considered the need to arouse the viewer emotionally, or to promote some action in the viewer relative to the content of the persuasive film, as the most important of the three presented. The technical quality of the film, and the need to present information in the film were not considered as important as behaviorally involving the viewer in the message of the motion picture. In other words, the film-makers considered the behavioral component of attitude to be more important in attitude change than the affective or cognitive components (Zimbardo and Ebbeson, 1970).

Because the production of persuasive films is considered controversial by some, several questions were included in the *FMS* to determine what film-makers thought about the propriety of producing films that were meant to persuade rather than to inform. Most considered persuasive films to be much more exciting to produce than other types of motion pictures. Only 10% reported ever having problems with the morality of producing attitude change films. However, most indicated that they would refuse to produce a film that was intended to promote a position that they did not believe in.

When asked to evaluate the success of their films, the respondents to the *FMS* were a little unsure of the impact their motion pictures had, even though they considered their films to be often, to usually, successful. When asked to indicate how they determined if their films actually changed attitudes, film-makers reported that they looked to the following indicators:

1. unsolicited letters	24%	(percent of film-makers who indicated this was how they evaluated the impact of their persuasive films)
2. sales	17%	
3. results of contests	16%	
4. informal surveys	13%	
5. comments from collegues	13%	
6. intuition	8%	
7. no way of knowing	7%	
8. formal experiments	2%	

Seventy-three percent of the film-makers who answered this survey thought that additional information about persuasive film making was needed.

DISCUSSION OF RESULTS

As stated above, the major purpose of this study was to partially validate the six guidelines for designing instruction when attitudinal outcomes were desired (Simonson, 1979). Based on the results of the FMS it is possible to point to several techniques that film-makers considered important or effective for persuasive film making. These techniques were directly related to Simonson's guidelines.

First, a target audience pre-assessment was identified as a very important pre-script writing procedure. A pre-assessment of the target audience would supposedly allow the film-maker to tailor the content of the film so that it would be relevant to the audience (Guideline #1), and so that new information could be presented (Guideline #2).

Film-makers considered movement in scenes, and the use of believable, realistic action and events as important when persuasion was desired. This finding supports the general intent of Guidelines #1 and #3. Film-makers also considered the presentation of new information about the topic to be an important consideration for a persuasive motion picture (Guideline #2).

Generally, professional actors were preferred to amateurs, probably because they would be able to portray their roles more realistically (Guidelines #1 & #3). Also, actors and actresses in persuasive films were considered most likely to be effective if they were as similar to the members of the target audience as possible, according to the film-makers surveyed. This was probably so the viewer would identify with the actors and with the persuasive messages they were delivering (Guidelines #1 & #3).

The film-makers surveyed thought that a teacher's guide with post-viewing discussion questions was fairly important in supplementing the persuasive impact of the film itself (Guideline #5). The "testimonial" and the use of big name stars, both commonly used techniques, were considered somewhat less effective than some other procedures.

Arousing the viewer seemed to be a highly desirable goal for a persuasive film (Guideline #6). This was accomplished by the way content was organized and presented, through the use of physically attractive actors and actresses, through the use of a dramatic musical score, or by using appropriate filming techniques. Generally, film-makers considered the involvement of the viewer in the message of the film as one of the most effective techniques for persuasion. If a viewer became involved in a film's message intellectually, because it promoted thinking about the topic, or behaviorally, because the viewer acted on the message of the motion picture, the possibility of attitude change in the direction advocated was considered as highly probable.

Based on the FMS results reported above, it would seem that there were several ingredients agreed on by film-makers as being likely to promote attitude change when they were included in the planning or production of persuasive films. Techniques considered important for successful persuasive films were that they should:

- be planned based on the results of a target audience assessment
- be arousing and designed to promote in the viewer some action, either intellectual or behavioral
- be written to present new information to the viewer on the topic
- be realistic and believable to the viewer
- be planned to include motion and action in scenes rather than static visuals
- be enjoyable, or fun, to watch
- be produced using professional actors rather than amateurs, and these actors should be identifiable, similar and realistic to the target audience

- be planned to be as non-verbal as possible
- be used with follow-up discussions as outlined in a teacher's guide that should accompany the film

This hypothetical persuasive film should be no longer than necessary, and have a budget of about $3000 per minute. Technical quality would be important for this motion picture, but only slightly more so than for any film. The "outs" ratio would probably be slightly greater for this film than for a regular informative film of the same length.

Techniques _not_ considered important or effective for persuasive films were:

- the use of color rather than black and white
- the film length
- the use of graphs, charts, and other written scenes
- the use of "scare" tactics that would attempt to show the dire consequences of not adhering to the message of the persuasive film
- the use of talking faces
- the use of animation
- the use of inspirational messages

Generally, it was thought that an effective persuasive film was one that was believable and realistic, presented new information, was fun to watch, promoted involvement or action in the viewer, was more visual than verbal, and was used correctly by the teacher.

Guidelines #4 was difficult to evaluate within the limitations of a mailed survey such as the _FMS_. The only "learners" involved in the planning and production of commercial persuasive films would be the film-makers themselves. Question #11 of the _FMS_ was included to determine if film-makers believed in the messages presented in the persuasive motion pictures they produced. According to Guideline #4, if a person participated in the behavioral act of planning and producing of a persuasive film their attitudes would be likely to come in line with the position advocated in the motion picture. Eighty three percent of the film-makers surveyed stated that they usually or always believed in the messages of their films. One even stated that often "...I changed my mind during production."

While it is possible that film-makers may avoid producing films that advocate ideas contrary to their own previously held beliefs, it would seem just as likely that the active involvement they had in the planning and production of persuasive films might have prompted them into more strongly accepting the message presented in their motion pictures. The act of persuading persuades, and Guideline #4 is supported.

Certainly, the results and conclusions of this study should be somewhat suspect. Film-makers are an independent group. Several commented on their FMSs that the questions asked were superficial and did not get to the "real" issue of persuasive film-making. One even called the study "stupid". Hopefully, this evaluation was incorrect. It would be just as incorrect to attempt to use the techniques, procedures and recommendations found above as a perscription for persuasion. Rather, this information is intended as a guide for further research. The most obvious next step would be to evaluate actual films that were designed to persuade, and then to identify how successful they were. Techniques used in successful motion pictures could then be compared to the results reported here. The ultimate objective would be to determine if there are obvious procedures that if included in mediated instruction would contribute to desirable attitudinal outcomes.

Attitude formation and change are, and will continue to be, important goals of education. As society becomes increasingly complex, the need to promote socially acceptable ideas will become critically important.

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FILM-MAKER'S INVENTORY

DEFINITION: When completing this questionnaire, remember that for our purpose a Persuasive Film is a training or educational film that has influencing, persuading or changing attitudes as its primary purpose.

PART I: GENERAL INFORMATION

1. Is film-making your primary method of employment? Yes 100% No ____

2. If #1 was yes, how many years have you been a film-maker as the primary method of your employment? $\bar{x}$ = 18.6 years (years) RANGE = 1 → 40

3. How old are you? $\bar{x}$ = 46.4 (years) RANGE = 25 → 68

4. What is your sex? M 91% F 9%

5. What type of formal training in film-making have you had? (Check all that are relevant.)

Some college	16%
Bachelors degree	21%
Masters degree, or more	21%
Trade school	5%
No school training, only on-the-job training	37%

Name and location of college, school you attended, if any. ____ (school) ____ (location)

Mentioned more than once: USC HARVARD CUNY COLUMBIA UCLA IOWA

6. Have you had any formal training in producing strictly persuasive educational films rather than informative or "how-to" films? Yes 9% No 91%

If yes, explain what kind.

7. How large, in numbers of full-time employees, is the film-making company where you work?
____ (number of employees) $\bar{x}$ = 11.7 RANGE = 1 → 35

8. How many films, of all types, have you been in charge of producing? $\bar{x}$ = 142.6 (Number) RANGE = 1 → 2000

9. How many persuasive education films have you been in charge of producing? $\bar{x}$ = 29.3 (Number) RANGE = 1 → 200

10. What was the average length of the persuasive educational films you have produced? $\bar{x}$ = 18.3 (In minutes) RANGE = 2 → 30

11. How would you estimate the market for persuasive films will change in the next 10 years? (Check one)

increase considerably	43%
increase a little	30%
stay about the same	20%
decrease a little	6%
decrease a lot	1%

12. What percentage of the educational/instructional film market is for films that persuade rather than those that inform? (Check one).

10% or less	20%
11-40%	40%
41-59%	20%
60-89%	20%
90% or more	

13. In your opinion, do you feel our definition of a persuasive film is a valid one? Yes 78% No 22%

If not, could you give us a different one?

14. What do you estimate would be the average cost of a 10 minute persuasive educational film?

$\bar{x} = 29,200$ RANGE = 13,000 → 65,000
(estimated cost)

15. How would the cost of a average 10 minute persuasive film compare to an informative educational film of the same length? (Check one)

5 cost a lot more _____
4 cost a little more _____
3 cost about the same _____ $\bar{x} = 3.69$
2 cost a little less _____
1 cost a lot less _____

PART II: PERSUASIVE FILM PRODUCTION

1. Do you feel that persuasive films are planned and produced differently than other educational films? (Check one)

5 very differently _____
4 somewhat differently _____
3 a little differently _____ $\bar{x} = 3.79$
2 almost the same _____
1 exactly the same _____

2. How important is a formal, pre-script writing, target audience assessment in the production of a persuasive film. (Check one)

5 critical to success _____
4 important but not critical _____
3 good idea, if possible _____ $\bar{x} = 4.27$
2 only in rare instances _____
1 not necessary, the techniques are basically the same _____

3. When comparing persuasive films to other educational films, how important is the technical quality (e.g. color intensity, editing)? (Check one)

5 more critical _____
4 more important _____
3 the same as for any film _____ $\bar{x} = 3.59$
2 not overly important _____
1 less important than for any other type of film _____

4. When comparing persuasive films to other educational films how important is it to: (Circle one for each item)

	Very important				Not very important	
• use of many scenes to keep the action moving rather than few scenes	5	4	3	2	1	$\bar{x} = 3.63$
• use of color rather than black and white	5	4	3	2	1	$\bar{x} = 3.40$
• use of motion in the filmed action rather than static actors, objects or graphics	5	4	3	2	1	$\bar{x} = 4.52$
• present new information on the topic	5	4	3	2	1	$\bar{x} = 3.85$
• produce a shorter film rather than a longer film	5	4	3	2	1	$\bar{x} = 3.56$
• use believable or realistic scenes, events or actors rather than abstract scenes or objects	5	4	3	2	1	$\bar{x} = 4.04$
• use of an arousing or dramatic musical score for the film	5	4	3	2	1	$\bar{x} = 3.78$

5. Compare the "outs" ratio for persuasive films you have made to general informative educational films. (Check one)

5 much greater _____
4 greater _____
3 about the same _____ $\bar{x} = 3.59$
2 less _____
1 much less _____

6. If you were planning a persuasive film how would you rate the following techniques in terms of their increasing the likelihood of influencing your audience?

1 = "a must" for persuasive films
2 = nice, if possible, or appropriate
3 = no more important than for any film
4 = I wouldn't use at all

(Place the number in the space that most closely matches your opinion of the importance of each technique.)

$\bar{x}$ = 2.48 hire a big name star to promote your position (e.g. George Brett, Walter Cronkite)
$\bar{x}$ = 2.56 inspirational messages must be presented
$\bar{x}$ = 2.01 hire professional actors rather than amateurs or "whoever is available"
$\bar{x}$ = 1.78 conduct a target audience pre-planning assessment
$\bar{x}$ = 2.31 include a teacher's guide with film follow-up discussion questions
$\bar{x}$ = 2.07 present "new" information on the topic to the audience
$\bar{x}$ = 2.13 have actors/people in the film that are as similar to the target audience as is possible
$\bar{x}$ = 2.35 use testimonials from the "man in the street" (those affected by the topic of the persuasive film)
$\bar{x}$ = 3.03 use graphs, charts and other visual methods of presenting factual information
$\bar{x}$ = 3.00 use title scenes to present verbal information visually

7. Several general characteristics of educational films are listed below. Please rate each as to whether it would be one you might consider important for a persuasive film.

1 = an excellent technique for persuasion
2 = OK for any film
3 = not a good procedure if you want to persuade

$\bar{x}$ = 1.40 make the film "fun" to watch
$\bar{x}$ = 2.48 "scare" the audience by presenting the dire consequences of not following the recommendations of the film
$\bar{x}$ = 2.17 use "animation"
$\bar{x}$ = 2.43 use "talking faces"
$\bar{x}$ = 1.26 attempt to "arouse" the audience intellectually, sexually, or emotionally
$\bar{x}$ = 1.86 use physically attractive actors or actresses at critical points
$\bar{x}$ = 1.42 present factual information
$\bar{x}$ = 1.27 be as realistic in presenting the story as possible
$\bar{x}$ = 2.00 present both sides of an argument and let the viewer reach his/her own conclusions
$\bar{x}$ = 2.67 use many title (written information) scenes
$\bar{x}$ = 1.78 be as "non-verbal" as possible (i.e. use as few words as possible)

8. Please rank the three statements in order of their importance for a persuasive film.

1 = most important
2 = next in importance
3 = least important of the three

(Rank 1, 2, or 3. Use each rank only once)

$\bar{x}$ = 2.37 the technical quality of film-making techniques used in the film must be exemplary
$\bar{x}$ = 2.31 the film must present considerable information to the viewer about the topic so that informed decisions can be made
$\bar{x}$ = 1.23 the film must arouse viewer emotionally or promote some action in the viewer relative to the topic presented in the persuasive film

9. As a film maker, how professionally exciting is it for you to produce persuasive films, rather than regular educational films? (Check one)

5 much more exciting _____
4 more exciting _____
3 about the same _____ $\bar{x}$ = 4.25
2 less exciting _____
1 not much fun at all _____

10. Have you ever had any problems with the morality of producing films that are primarily intended to persuade rather than inform? (Check one)

- yes 10%
- sometimes 20%
- no 70%

Please explain your answer.

11. After you have produced a persuasive film do you generally feel strongly supportive of the persuasive message of the film or do you usually remain detached from the content of films you produce? (Check one)

4 I always "believe in" the messages of my films ____
3 I usually think the messages I present are correct ones ____ $\bar{x} = 3.23$
2 Some messages I produce films about affect me, and some do not ____
1 I never become involved with the content of my films ____

12. Do you feel your persuasive films have been successful in changing attitudes or opinions of viewers? (Check one)

5 always successful ____
4 usually successful ____
3 often successful ____
2 sometimes successful ____ $\bar{x} = 3.27$
1 no way of knowing ____

13. How do you know if your films are successful at persuading? (Check all relevant methods you have used)

• formal experimentation	2%
• informal surveys and follow-ups	13%
• unsolicited letters and comments from viewers	24%
• sales of your persuasive films	17%
• results of contents and screenings	16%
• comments from other film-makers	13%
• intuition	8%
• no way of knowing	7%
• others, please list	

14. In your opinion, do film-makers need more information about the techniques for producing films that persuade? (Check one)

• yes, film-makers need a lot more information	43%
• some additional information is always nice	30%
• no more than information about any other type of film	27%
• film-makers probably know more about persuasive films	0%
than other types	0%
• it is a waste of time to try to find out more on this topic	0%

15. Who purchases persuasive films that you have produced? (Check all that are relevant)

• individual school districts	12%
• regional education agencies	10%
• university film libraries	13%
• governmental agencies	18%
• businesses	16%
• professional or trade associations	15%
• individuals	1%
• film distribution companies	15%
• other	

16. When you think of film-makers who produce persuasive films whom do you think of?

____________________ (name) ____________________ (address)

17. Are you aware of any formal training programs, schools, institutes, or materials that give specific advice to film-makers who wish to make persuasive rather than other types of films? If so, where or what are they?

Yes ____ No ____ If yes, would you give more information?

18. Could you supply us with the title of one exemplary persuasive film that you know about?

____________________ (title) ____________________ (distributor)

YOUR NAME ____________________ YOUR ADDRESS ____________________

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Some Observations on the Available Research
for the Media Manager

by

Dr. John Splaine
Associate Professor
Educational Communications
University of Maryland
College Park, Maryland 20742

Prepared for the National Convention of the Association for Educational Communications and Technology. Philadelphia, Pennsylvania. April 5-10, 1981.

Division of Educational Media Management and the Research and Theory Division

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I. Introduction

At this time there appears to be a shortage of periodical literature with a research base that is concerned with media management. There are some sources of information such as textbooks, periodicals, academic journals, dissertations, formal and informal courses, and the networks the media managers have created. But there is little experimental research being reported on the subject, nor is there much action research, nor are there many reports of field studies, nor are there adequate reports of historical developments, nor are there adequately developed surveys (either through valid and reliable questionnaires or through the more complex, more time-consuming, and potentially more valuable structured interviews) for the media manager to use.

Yet, media managers who are busy in their every-day work, who must be eclectic in their knowledge, and who must know something about a great number of subjects need the results of research available and obtainable. This research needs to be reported concisely, with an adequate synthesis, and with potential for generalizability. Its generic components should have implications for contemporary practice and should be able to be applied to a variety of situations. Consequently, the question that needs to be answered is: Where is the literature that provides research results that are apropos to the time-pressed practitioner?

II. What research is presently available to the media manager?

The discussion that follows is focused on the available periodical literature and only a few of the available periodicals are examined.[1]

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[1] Periodicals were chosen because they are issued most frequently and are generally included with association memberships. The selection of the periodicals was an arbitrary decision made by this writer.

A. The Educational Communication and Technology Journal has continued its orientation toward reporting experimental research. It has continued the work of its predecessor, Audiovisual Communication Review. Suffice it to say that the Journal does not focus on media management,and that it takes effort to find articles that have any immediate relationship. Of course, all articles in the field of educational communications and technology have at least some tangential connection or we would not be able to belong to a single organization with a common name.

Clearly, the readers of the Journal do have something in common. But to find immediate application to the problems inherent in media management in ECTJ, one does have to search. For example, it is indeed good to know about "Interaction Between Locus of Control and Three Pacing Procedures in a Personalized System of Instruction Course,"[2] but it is not absolutely essential unless one stretches the essential responsibilities of the media manager. Consequently, other than tangential applications, none of ECTJ's Volume 28, Numbers 1-4 (Spring, Summer, Fall, Winter, 1980) had articles that help media managers to handle tomorrow's problems. Nor, in fairness, does ECTJ attempt to.

Indeed, only one article in Volume 28, "Advisement and Management Strategies as Design Variables in Computer-Assisted Instructions,"[3] had the word

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[2] Robert A. Reiser, "Interaction Between Locus of Control and Three Pacing Procedures in a Personalized System of Instruction Course," Educational Communications and Technology Journal, Vol. 28 (Fall, 1980), pp. 194-202

[3] Robert D. Tennyson and Thomas Buttrey, "Advisement and Management Strategies as Design Variables in Computer-Assisted Instruction," Ibid., pp. 169-176.

"management" in its title and this article was about locus of control and instructional design concepts and only peripherally about the concepts of management.

So for immediate help and generic potential, the media manager must look elsewhere.

B. The Journal of Instructional Development does come closer to meeting the immediate needs of the media manager. The problem is that instructional development is but one of the functions of the school, college, or university media manager; albeit, an important one. Unless, of course, it is clear that instructional development is the main function of the job -- then the media manager should be called something else. But certainly JID is of more immediate relevance to the media manager than is ECTJ even though its main concern is other than management.

The Journal of Instructional Development has an Associate Editor for Case Study and Management on the Editorial Board and there are other departments that are related to the concerns of the media manager. Additionally, a number of the Consulting Editors are known for their work in management. But again, media management is but one focus. The article by Castelle G. Gentry, "A Management Framework for Program Development Techniques," is without a doubt useful.[4] But some ot the other articles are of less value to the media manager and being short of time, the media manager will need to do a lot of judicious skipping in order to find help solving everyday problems.

C. The magazine, Educational Technology, which is subtitled: "The

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[4] Castelle G. Gentry, "A Management Framework for Program Development Techniques," Journal of Instructional Development, Vol. 4 (Winter, 1980-81), pp. 33-37.

Magazine for Managers of Change in Education," has entire editions examining general issues in educational technology, the state of the art, and a variety of special topics. Most of the issues are of a general nature and consider a pot pourri of educational issues.

As an illustration, in the same issue articles may be as directly relevant as David M. Moore's "Educational Media Professionals' Perceptions of Influence and Prestige in the Field of Instructional Technology: A National Survey,"[5] and Warren S. Williams, Robert Smith and Wayne Esch's Using New Computer Software Products to Manage and Report Educational Data,"[6] or be something as estoteric as George A. Sprague's "Cognitive Psychology and Instructional Development: Adopting a Cognitive Perspective for Instructional Design Programs in Higher Education."

Educational Technology contains articles that report experiments, surveys, case studies, and there are essays. As with any publication with such diversity, the quality can vary. Much of Educational Technology, however, is applicable to the media manager and some of the articles will help the media manager with immediat problems.

D. The official publication of the Association for Educational Communicatio and Technology, Instructional Innovator, contains a number of news items and special features such as: "Clips," "Feedback," "Speak Out," "Notes From the Field, "Instructional Resources," "News Products," and editorials. The periodical is essential to anyone in educational communications and technology. It is aimed at a general audience so its direct applicability to the media manager varies depending on the timeliness of the articles and the focus of a specific issue. Few of the articles are based on systematic research which does not necessarily reduce their value, but does reduce their generic potential.

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[5] David M. Moore, "Educational Media Professionals' Perceptions of Influence and Prestige in the Field of Instructional Technology: A National Survey," Educational Technology, Vol. XXI (February, 1981), pp. 15-23.

[6] Warren S. Williams, Robert Smith, and Wayne Esch, "Using New Computer Software Products to Manage and Report Educational Data," Ibid., pp. 46-51.

[7] Gregory A. Sprague, "Cognitive Psychology and Instructional Development: Adopting a Cognitive Perspective for Instructional Design Programs in Higher Education," Ibid., pp. 24-29.

E. The Division of Educational Media Management Newsletter is published quarterly by the Association for Educational Communications and Technology Division of Educational Media Management. For a "newsletter" is is exceedingly well done and spans a number of issues of concern to media managers. For example, R. Kent Wood and Don C. Smellie's article, "Videodisc: Implications and Anticipated Effects on the Field of Media Management,"[8] relates videodiscs directly to management as the title suggests. Another Article in the same issue does the same thing with microcomputers, Ronald F. Boehm's "Microcomputers and Media Manager."[9] In addition, Barbara B. Minor from ERIC Clearinghouse on Information Resources at Syracuse University has done a valuable section on "ERIC Resources for Media Management," in recent issues.

The Newsletter is not, however, research based nor does it pretend to be. Consequently, the question needs to be asked: Is there a void in the reported research aimed toward media managers? The one publication destined for media managers as a specific audience is not research based and the other publications that do have some applications and are research based are really serving either more general or more esoteric audiences. Where does the media manager then go? What is a possible model for reporting research in a concise, usable format?

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[8] R. Kent Wood and Don C.Smellie, "Videodisc: Implications and Anticipated Effects on the Field of Media Management," Division of Educational Media Management Newsletter, Vol. VIII (Winter, 1981), pp. 4-5, 13, 16.

[9] Ronald F. Boehm, "Micorcomputers and the Media Manager," Ibid., p. 6.

III. A Possible Model

The model of writing for media managers as proposed here is that the articles (not all of them, of course, there is nothing wrong with essays) be research based.[10] In addition, they should be concise, be clearly written, and be related to an important concern of managers at the local level. In order to provide such a paradigm, I have re-written for 1981, an article that was orginally published in 1975 entitled: "Media and the School Principal."[11]

The reason this article was chosen was because of the large number of requests for reprints and the fact that it was also printed in the Region 12 Media Newsletter which serves the Intermediate School Districts of Barry, Branch, Calhoun, Kalamazoo, and St. Joseph's, Michigan.[12] It is assumed that the requests for reprints and the request to print the article in the Region 12 Media Newsletter is an indication that the article was of some use and that the article was viewed as being of value to others.

Specifically, the article addresses the possible avenues that people interested in propagating educational communications might take in attempting to influence the school principal. This is a concern of daily importance facing media managers. The article provides some research support to bolster the thesis that is posited. The revised article follows.

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[10] If the term research is too strong or open to too many interpretations, then maybe the term "evidence-based" clarifies what I mean. The authors' should cite the evidence and/or research that they are using to support their argument. This makes a case study article, for instance, potentially more generic.

[11] John Splaine, "Media and the School Principal," Audiovisual Instruction, Vol. 20 (October, 1975), pp. 12-13.

[12] John Splaine, "Media and the School Principal," Region 12 Media Newsletter, 1 (January, 1977), pp. 5-6.

Elementary and secondary school principals hold crucial positions in relation to the introduction, use, and continued growth of educational media in the public schools.

School principals, through their formal as well as their informal powers, have a significant influence on policy-making at the building level. If the principal is convinced of the effectiveness of media, then the job of the media director in influencing shool policy is facilitated. To make the point even more cogent: in order to receive adequate funds, the media director must influence the school principal.

Principals must realize the potential of educational media. The principal is instrumental at the building level and many times the media director's only link with the District and County policy-makers. No one willingly allocates scarce resources unless he or she personally believes in the project or so respects the advocates of a given project that the advocate's opinions alone are seen as an adequate reason to support funding.

The principal's powers and opinions are important, as media directors must know, and they must be continually nurtured. As suggested above, one of the ways to influence building principals is through the prestige of one's position and through one's actions. Consequently, if the media director is considered by others to be a person of worth, if his opinions are taken into serious consideration, if he is on the councils of influence in the school (formal and informal); then the job of influencing policy decisions and of influencing the resultant funding decisions is considerably eased. But the preceding statement contains a lot of "ifs."

Of course, the more difficult task is to convince the principals of the worth of educational media in order to effect positive policy decisions. How can this be accomplished?

The following are a variety of procedures that can be used in influencing the school principal. They are neither hierarchial nor do they constitute a concatenation.

1. Having workshops in the school. If the workshops are effective (and hopefully the principal would be involved), the message will get to the principal.

2. Encouraging university professors who teach courses and workshops for school principals to use media in their courses and workshops. The old maxim applies here "You teach the way you were taught."

3. Seeing that principals examine materials that advocate and explain the use of a variety of educational media. For example, the recent literature contains a number of articles advocating the use of a wide variety of media in teaching and learning; and this position is being increasingly supported by the recent research concerning the different hemispheres of the brain and their respective need to be nurtured. Media directors should see that principals have an opportunity to examine Instructional Innovator, Media and Methods, Educational Technology, as well as the other information sources which convey the importance of using a wide variety of educational media.

4. Showing student and faculty projects to the principal. Whenever possible, media directors should see to it that exemplary and typical student and faculty projects are shown to their principals.

5. Helping the principal develop educational materials for his or her own use. One of the best ways to convince someone of the effectiveness of educational media is to encourage and facilitate their use. If a principal successfully uses a slide-tape presentation, a film that was produced in the school, a well done videotape, or even a set of transparencies then he or she will be more impressed

with the importance of educational media.

6. Encouraging principals to participate in educational media institutes. There is some evidence to support the assertion that probably the most effective (although possibly the most expensive) means of conveying to principals the importance of educational media is through institutes which involve them in a residential program for two to eight weeks. The National Defense Education Act and the Educational Professions Development Act provided the sources for funding such institutes.[13]

Some of the institutes that had been conducted under NDEA and EPDA grants were specifically designed for administrators. This writer was an instructor in one such institute at the University of New Hampshire in 1966 under the directorship of the late Paul G. Spilios. In this Institute thirty administrators (approximately one half of the participants were building principals) spent six weeks producing and using educational media and discussing the merits and implications of its use.

These federally-supported institutes have yielded some intriguing results. Lewis v. Bias, Donald G. Perrin, and Clarice Y. Leslie studied the effects of the media institutes on its participants.[14] They state:

> One result of the media institutes was to cause a shift of some of the more highly trained media personnel from the school building level to outside offices. Except for Library-Media personnel, the school system did not provide sufficient or adequate jobs to retain and fully utilize all of the media personnel trained by the institutes. The reverse appears to be true of county, district, and state level positions, including college instruction. The institutes provided a source of trained manpower with experience in public school teaching.

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[13] It is indeed ironic that President Ronald Reagan expects Secretary of Education, Terrel H. Bell, to encourage more efficiency and effectiveness through the use of educational innovations while having fewer programs to educate the "innovators."

[14] Lewis V.Bias, Donald G. Perrin, and Clarice Y. Leslie, A Retrospective Look at at Educational Media Institute Programs in U. S. Office of Education, 1965-71. College Park, MD.: University of Maryland, 1973

This latter point is extremely important in that these newly trained administrators at the district and county levels were then in a position to influence policy and funding decisions at those levels. Significantly, according to Bias, Perrin, and Leslie:

> ...there is an increase in directive-administrative levels responsibilities of 7.8 percent and a decrease in professional responsibilities of 5.9 percent....This suggest a substantial change in job responsibilities came about as a result of the institute experience.
>
> Another benefit of the institutes was that many participants followed their experience by conducting workshops upon returning to their jobs. Over 25 percent of those attending workshops given by graduates were principals.

The education and cultivation of principals in media education is essential to increase support.

Residential media institutes, such as those sponsored through the NDEA and EPDA legislation, appear to be the most effective means to this end; but the institutes are expensive, possibly impractical for a number of principals and the political climate of the early 1980's is inimical to increased federal support going to such institutes.

Consequently, most of the educators who are interested in the introduction, use and continued growth of educational media may have to use the other methodologies that have been suggested or will have to modify the suggestions made here or will have to invent their own. Clearly, the education of building principals in the use of educational media must be a priority item for media directors and the effort must be made.

IV. Conclusions

1. There is a dearth of periodical literature available that is directed toward the media manager. There is an even greater lack of material that is research based and that is written in a succinct and clear style.

2. The Division of Educational Media Management Newsletter is the most directly applicable source of information for the media manager, but the articles in the Newsletter are not necessarily research based and do not go through an established peer review system and are, therefore, limited generically.

3. The model presented in this paper is proposed as a paradigm for how an article might be written with at least some reference to established findings that emanate from the research.

4. The question of whether there is enough periodical literature which addresses the needs of the media manager for research based information must be answered in the negative. A cavernous gap exists.

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The Role of Stimulus-Size on Performance in the Embedded-Figures-Test and in the Rod-and-Frame-Test and the Implications of this Role for the Perceptual and Cognitive Style Constructs in Educational Technology Research*

Michael J. Streibel
Instructional Systems Program
Division of Curriculum and Instruction
The Pennsylvania State University
University Park, PA. 16802

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ABSTRACT

Three experiments were performed in which subjects were exposed to two sizes of the Embedded-Figures-Test (EFT). Subjects in the third experiment were also exposed to two sizes of the Rod-and-Frame-Test (RFT). In the first experiment, where the EFT had a size-differential of 1 to 4 (with the standard Witkin EFT taken as unity), a non-significant size-effect and a significant rank-correlation was found for the performances on the two sizes. Furthermore, the performances of field-dependent subjects (FD Ss: as defined by performances on the standard EFT) and field-independent subject (FI Ss) did not interact significantly with the size factor. In experiments 2 and 3, where the EFT size differential was 1 to 8,a non-significant and a significant size-effect was found for all subjects, respectively. In both experiments, however, a significant interaction between the field-dependency and stimulus-size factors was found. FD Ss, in effect, became significantly more field-independent, and FI Ss became significantly more field-dependent. Finally, in experiment 3, the performances of all Ss on the two sizes of the EFT (i.e., 1 to 8 size differential) and the two sizes of the standard Witkin RFT (i.e., 1 to 4.5 size-differential) were compared. A significant stimulus-size effect was found in the EFT with all Ss becoming more field-independent, and a significant stimulus-size effect was found in the RFT with all Ss becoming more field-dependent. These results and their implications for educational technology research are discussed.

INTRODUCTION

It has been shown recently that changing the retinal size of a rod and frame (i.e., the angle that the rod and frame projects onto the retinal surface) modulates performance on the Rod-and-Frame-Test (RFT) such that the smaller the retinal angle, the lower the rod and frame effect (Ebenholtz, 1977; Ebenholtz & Benzschawel, 1977). Since the RFT and the Embedded-Figures-Test (EFT) are both used as measures of perceptual style (Witkin & Asch, 1948; Witkin, 1949; Witkin, Lewis, Herzman, Machamer, Meissner, & Wapner, 1954; Witkin, Dyk, Faterson, Goodenough, & Karp, 1962; Witkin, Oltman, Raskin, & Karp, 1971), the question was raised as to whether the same pattern of stimulus-size effect would be found in the EFT as in the RFT.

Witkin and his associates have long argued that the EFT and the RFT both measured the same thing. Perceptual field-dependence-independence, or more generally, perceptual style, was defined such that (Witkin, et al., 1971):

> In a field-dependent mode of perceiving, perception is strongly dominated by the overall organization of the surrounding field, and the parts are experienced as 'fused.' In a field-independent mode of perceiving, parts of the field are experienced as discrete from organized ground.

The claim that the EFT and the RFT measured the same thing has not been without its critics (Arbuthnot, 1972; Wachtel, 1972) and has usually been supported or denied on the basis of correlational studies (Long, 1974; Schiff, 1980). The present study investigated this claim within an experimental paradigm: if the EFT and the RFT tapped a common perceptual mechanism (i.e., perceptual style), then one would expect a similar shift in performance on both tests when a common stimulus variable such as size was manipulated. (Streibel, 1980; Streibel & Ebenholtz, 1981).

EXPERIMENT I

Method

Apparatus. Two sizes of Form A of Witkin's EFT were constructed in a size-ratio of 1 to 4. The "small" figures were constructed out of COLORAID paper and mounted on 15" x 20" CRESSENT #300 illustration boards. Each of the "small" figures of Form A (i.e., twelve complex figures, eight simple figures, and two practice figures) matched the figures of the original EFT produced by the Consulting Psychologists Press (Witkin et al., 1971) in color, shape, size, and orientation. Black lines in these figures were produced by using 1/64"-wide black-matte CHARTPAK pressure-sensitive graphic tape. The illustration boards were covered by .075" clear acetate and taped around the entire edges with SCOTCH Magic Transparent tape. The "medium" figures of Form A were four times as large as the "small" figures but were mounted on the same size illustration boards.

The small and medium-sized figures were manually placed on a black, wooden, table-top easel such that the center of each figure was 24" from, and perpendicular to, each subject's eye. The small figures therefore ranged in visual angle (i.e., the angle that the outer limits of the figures subtended on the retinal surface) from 2.4^{o} to 6.2^{o} while the medium figures ranged from 9.6^{o} to 24.8^{o}. A 1/8" x 15" x 20" clear LEXAN sheet was placed on top of each figure so that a subject's manual tracing of the embedded figures would not scratch the original figures.

Procedure. Subjects sat in an upright position with their chins in a chin rest. The experimenter sat next to them on their right. The experimental room was dark except for a florescent lamp and an incandescent lamp which were placed so that no light would shine directly into a subject's eyes. The test was administered according to the standard EFT instructions (Witkin et al., 1971) except that each subject saw six figures of the small EFT and six figures of the medium EFT (or vice versa) in the standard order instead of twelve figures of the same size.

Design. Eight male and nine female college students between the ages of 18 and 32 from a number of introductory psychology classes at the University of Wisconsin were tested for their ability to disembed small and medium-sized EFT figures. They were given an experimental credit for their participation. These credits were part of a standard requirement for introductory psychology courses. The dependent variable reflected a speed and accuracy measure, and, was calculated as the average response time for six small and six medium-sized figures of the EFT for each subject. Sex (i.e., m vs. f), stimulus size (i.e., s vs. m), sequence (i.e., s → m vs. m → s), order (i.e., 1st 6 figures vs. 2nd 6 figures), and order-within size (i.e., figures 1-6 vs 7-12 of Witkin's EFT) were counterbalanced and the effects of these factors were calculated by a special ANOVA (Grant, 1949). One subject was dropped because she could not disembed the figures.

Results

Analyses of the EFT data from all subjects. A special ANOVA was calculated with these data (Grant, 1949) and neither a significant sequence effect [F(1,14)=0.14, n.s.], order effect [F(1,14)=0.05, n.s.], nor size effect [F(1,14)=2.10, n.s.) was found. The mean EFT response times for all subjects were as follows (see Table 1):

Table 1 about here

Males were consistently faster than females but separate one-way ANOVAs resulted in a non-significant sex effect [small EFT F(1,14)=1.89, n.s.; medium EFT F(1,14)=2.71, n.s.].

Finally, a significant Pearson correlation coefficient [r=.694, p< .005] was found when the data from all subjects on the small and the medium EFT were compared. Subjects who were FD on the small EFT, therefore, tended to be FD on the medium EFT. A Spearman rank correlation coefficient [r_s=.5853, t (15)=2.7, p< .01] confirmed this conclusion.

Analyses of the EFT Data from FD and FI subjects. Since there was no significant sequence effect, the data from the two sequences were pooled and then ranked according to performance on the small EFT. The latter was done because the small EFT most closely approximated the size of Witkin's standard EFT. The 16 scores appeared normally distributed and the top (i.e., fast response times) and bottom thirds (i.e., slow response times) were defined as EFT field-independent (EFT FI) and EFT field-dependent

(EFT FD) respectively. Table 2 summarizes the mean EFT data for these two groups. (see Table 2):

Table 2 about here

Although an ANOVA of data from the two groups showed a significant difference between the FI and FD subjects [F(1,8)=32.23, $p < .01$], neither a size effect [F(1,8)=.02, n.s.] nor a field-dependency x size interaction [F(1,8)=3.41, n.s.] was found.

Discussion

The results of the first experiment indicated that the small and the medium EFT (i.e., 1 to 4 size differential) could reliably be considered interchangeable measures of the same thing.

EXPERIMENT 2

Method

Apparatus. Two sizes of Form A of Witkin's EFT were constructed in a size-ratio of 1 to 8. The small-sized EFT was identical to that used in experiment 1. The "large" EFT was constructed out of the same stock of materials as was used for the figures in experiment 1 except that the black lines of the large figures were constructed out of 1/8" black-matte CHARTPAK tape. The large figures, however, were mounted on 20" x 26.6" illustration boards.

The table-top stand which supported the EFT figures was moved to a distance of 20" from each subject's eyes in order to amplify the size of the large figures. The small figures, therefore, ranged in visual angle from 2.6° to 6.6° while the large figures ranged from 20.8° to 52.8°.

Procedure. All conditions in experiment 2 were identical to those in experiment 1.

Design. Twelve male and fourteen female college students between the ages of 18 and 25 from a number of introductory psychology classes at the University of Wisconsin were tested for their ability to disembed small and large-sized figures. The experimental design was identical to that used in experiment 1. Two female subjects were replaced because they displayed extremely large EFT response times relative to the other subjects (i.e., greater than three standard deviations above the group mean for one size of the EFT).

Results

Analyses of the EFT data from all subjects. An ANOVA of the data in experiment 2 (Grant, 1949) did not show a significant sequence effect, [$F(1,22)=4.00$, n.s.] or a significant size effect [$F(1,22)=0.42$, n.s.], but did indicate a significant order effect [$F(1,22)=9.50$, $p< .05$]. The latter was attributed to a simple practice effect. The mean EFT response times for all subjects were as follows (see Table 3):

Table 3 about here

As in experiment 1, males were consistently faster than females and were so to a significant degree [small EFT $F(1,22)=9.78$, $p< .01$; large EFT $F(1,22)=7.08$, $p< .05$].

A significant Pearson correlation coefficient [$r=.4111$, $p< .01$] was found when all the small EFT scores were compared with all the large EFT scores. A Spearman rank correlation calculation, however, failed to result in a significant correlation coefficient [r_s=.3383, n.s.]. Ranking performance on the small EFT, therefore, could not be used to predict the rank of a subject's performance on the large EFT.

Analyses of the EFT data from FD and FI subjects. The data from experiment 2 was then ranked on the basis of performance on the small EFT. Table 4 summarizes the mean EFT scores of the EFT FD and EFT FI subjects (i.e., the upper and lower thirds of the distribution - 8 subjects within each group):

Table 4 about here

An ANOVA of the data from these two groups did not show a significant size effect [F(1,14)=1.45, n.s.] but did show a significant field-dependency effect [F(1,14)=8.24, $p < .05$], and a significant field-dependency/stimulus-size interaction [F(1,14)=15.49, $p < .01$].

Discussion

The results of the second experiment indicated that the small and the large EFT (i.e., 1 to 8 size differential) could not be reliably considered interchangeable measures of the same thing. Although a significant size effect was not found for the entire group's performance when the size of the embedded figures changed from 1 to 8, a significant interaction between the field-dependency factor and the stimulus-size factor was found for the EFT FI and FD groups. EFT FI subjects (as defined by the standard, or small, EFT), in effect, became significantly more FD whereas FD subjects became significantly more FI. The EFT performances of both groups, however, did not reach a common value. A non-significant rank correlation of the data from the entire group confirmed the conclusion that the two sizes of the EFT might not be measuring the same thing.

EXPERIMENT 3

Method

Apparatus. The two sizes of Form A of Witkin's EFT were identical to those used in experiment 2 as were the procedures for administering and scoring the test. The RFT apparatus, however, was constructed specifically for this experiment.

The small and the large-sized rod and frame consisted of a luminous line and square outline-frame, respectively. They were painted on separate, black CRESCENT #648 illustration boards with PALMER's luminous paint. The dimensions of the small rod and frame were 8.5 cm. x 0.6 cm, and 10.7 cm. x 0.6 cm., respectively. The dimensions of the large rod and frame were 40.1 cm. x 0.6 cm. and 50.5 cm. x 50.5 cm. x 0.6 cm., respectively. An identical line width was chosen for all figures so that the same light intensity would be radiated from any unit area.[1]

The illustration boards containing the two luminous outline-frames were mounted on a stand so that they were tilted 20° clock-wise when facing the subject head-on, and, had their inner black regions removed so that the rod could rotate freely in the same plane as the frame. The two luminous rods had their own mount and were rotated manually around the central axis of the frame.

A large protractor was built into the rear part of the table-top apparatus and permitted the degree of rod tilt to be measured with a 0.5° accuracy. Subjects sat in an upright position with their hands on their lap and their chins in a chin rest. They gazed directly into the rod-and-frame figures from a distance of 26.4 inches. The small rod-and-frame therefore subtended a 9.1° visual angle while the large rod-and-frame subtended a 41.3° visual angle.

Before each RFT, the four RFT figures were simultaneously exposed to room light for 5 minutes in order to stimulate an equivalent amount of luminescent radiation. These figures were then stored out of the light in order to allow the brightest levels of luminescence to decay. The experimental room was totally dark during the RFT and all surfaces in the room were painted with black, non-glass paint or covered with black, non-reflective cloth. The latter was done in order to eliminate even the faintest visual orientation cues since it was known that room illumination-levels could effect the outcome of the RFT (Irving & Henderson, 1971; Long, 1973).

Procedure. Subjects adjusted the small and large rod to the apparent gravitational vertical from starting positions of 25° clockwise and 25° counter-clockwise, with bracketing permitted (Ebenholtz, 1977). The rod-rotation rate was experimenter-controlled. The upright orientation of the rod was measured first in a no-frame condition, and then, within an appropriately-sized frame condition where the frame was tilted 20° clockwise. The rod-and-frame effect was defined as the algebraic difference between the average of the two settings taken with the tilted-frame and no-frame conditions. RFT field-independence (RFT FI) was defined as the upper third of the distribution of scores (i.e., the least deviation from the true gravitational upright) and RFT field-dependence (RFT FD) was defined as the lower third.

Design. Each of the sixteen male and eighteen female subjects was tested in all of the EFT and RFT conditions. Sixteen subjects were exposed to the EFT before the RFT while the remaining sixteen were exposed to the reverse sequence. The second test began within minutes after the first test was finished. The design of the EFT was otherwise identical to that used in experiment 2. Two female subjects were replaced because they displayed extreme field-dependence relative to other subjects (i.e., EFT scores greater than three standard deviations above the group mean).

The RFT consisted of eight trials of either a small to large or a large to small sequence. The four trials within any particular size consisted of the rod only condition with a 25° clockwise and 25° counter-clockwise rod-starting position followed by a 20° clock-wise tilted frame condition with the same two rod starting positions. The RFT dependent variable for any particular sized frame was the difference between the average rod setting in degrees of the frame-present and the frame-absent conditions. The scores from the two rod-starting positions (i.e., 25° cw and 25° ccw) were averaged in order to counterbalance any rod starting-position effects (Werner & Wapner, 1952; Morant & Arnoff, 1966). A positive RFT deviation indicated that the tilted frame modified the subject's perception of the upright in the direction of the frame. The rod, in such a case, was therefore set in the direction of the tilt of the frame in order to be aligned with the perceived upright.

Results

Analyses of the EFT data from all subjects. An ANOVA of the data in experiment 3 (Grant, 1949) did not show a significant sequence effect [F(1,30)=.53, n.s.], but did show a significant order effect [F(1,30)=4.74, p< .05] and size effect [F(1,30)=6.64, p< .025]. The lack of a significant EFT sequence effect (i.e., s→ l vs l → s) permitted the data from the two sequences to be pooled. The significant EFT order effect (i.e., 1st 6 figures vs. 2nd 6 figures) was probably due to a simple practice effect. The significant EFT size effect meant that all subjects as a group disembedded the large figures significantly faster than they disembedded the small figures. The mean EFT response times were as follows (see Table 5):

Table 5 about here

Males were slightly slower than females, but, this difference was not significant [small EFT F(1,30)=.45, n.s.; large EFT F(1,30)=0.02, n.s.].

Analyses of the EFT data from EFT FD and FI subjects. The EFT data from experiment 3 was ranked on the basis of performance on the small EFT. Table 6 summarizes the mean EFT scores of the EFT FD and FI subjects (i.e., the upper and lower thirds of the distribution - 11 subjects within each group).

Table 6 about here

An ANOVA of the data from these two groups revealed a significant size effect [F(1,20)=23.15, p< .01] and a significant interaction between the field-dependency and stimulus-size factors [F(1,20)=47.97, p< .01]. Further analyses showed that the performance of the EFT FI & FD groups *on the large EFT* did not differ significantly from each other [t(21)=.14, n.s.].

Analyses of the RFT data from all subjects. An ANOVA of the Rod-and-Frame-Test (RFT) data (Grant, 1949) did not show a significant sequence effect [F(1,30)=.66, n.s.] nor a significant order effect [F(1,30)=.04,n.s.], but did result in a significant size effect [F 1,30)=48.56, p< .001]. This was consistent with earlier RFT research (Ebenholtz, 1977). The mean RFT response times for the entire group were as follows (see Table 7):

Table 7 about here

Analyses of the RFT data from RFT FI & FD subjects. Since there was no sequence effect, the RFT data was ranked according to performance on the large RFT. This was done because earlier research had shown that the large-sized frames were better able to discriminate field-dependency (or perceptual style) than smaller frames (Ebenholtz, 1977). Table 8 summarizes the mean RFT scores for the RFT FI & FD subjects (i.e., the upper and lower third of the distribution -- 11 subjects within each group):

Table 8 about here

An ANOVA of these data resulted in a significant size effect [F(1,20)=114.26, p< .001], as well as a significant difference between RFT FI and FD subjects [F(1,20)=57.76, p< .001], and a significant interaction between the field-dependency and frame-size factors [F(1,20)=33.38, p< .001]. The interaction effect was the result of RFT FD subjects becoming more field dependent at a faster rate than FI subjects as the size of the stimuli got larger.

Correlational Analyses of the EFT and RFT data from all subjects. A Pearson correlation coefficient matrix of the entire data set from experiment 3 did not result in any significant correlations (see Table 9):

Table 9 about here

Hence, the possibility existed that all four tests (i.e., small and large EFT and RFT) measured independent perceptual processes. Since the small-large RFT correlations came close to significance for the entire group, a Spearman rank-correlation was performed on the entire data (see Table 10):

Table 10 about here

This time, the small-large RFT correlations reached significance for the entire group [$r_s = .3222$, $p < .05$], which, in turn, was attributed to the female RFT performance [$r_s = .4757$, $p < .05$].

A further test of all the data was made in order to see if any other associations could be found. A 2x2 Fisher exact non-parametric test based on a median split only resulted in a significant association between the small and the large RFT [p=.0055]. All other measures indicated that the performances were made by independent groups even though each person took part in all conditions.

Analyses of the EFT and RFT data from FI and FD subjects within each test. It was hypothesized that perhaps if performance on the large RFT were used as a general definition of FI and FD, then one would have a better predictor of performance on the EFT. Accordingly, the EFT scores of subjects defined FI & FD on the RFT were examined. An ANOVA of this EFT data indicated that subjects could not be distinguished as FI or FD on the EFT if they were labeled as such on the RFT [F(1,20)=.10, n.s.]. Furthermore, RFT FI & FD subjects who displayed a significant interaction between the field-dependency and frame-size factors on the RFT did not display a significant interaction between field-dependency and stimulus-size on the EFT.

The converse of the previous argument was also examined: if performance on the small EFT were used as a general definition of FI and FD, could one predict performance of the RFT? Accordingly, the RFT scores of the EFT FI & FD subjects were examined. An ANOVA of this RFT data indicated that grouping subjects on the EFT did not distinguish these subjects as FI or FD on the RFT [F(1,20)=.22, n.s.].

Analyses of the small EFT data from all subjects in Experiments 1-3. A one-way ANOVA of the small EFT data from all subjects across all experiments showed that the mean performance levels on the small EFT did not differ significantly from each other [F(2,69)=.04,n.s.]. The three small EFTs were identical to each other and matched the Witkin EFT in figure-size, shape, color, and orientation. The one-way analysis of the small EFT data therefore indicated that since the three samples of subjects used in the three experiments came from the same population, the EFT analyses could be compared across experiments (see General Discussion below).

Discussion

The results of the third experiment confirmed the finding of the second experiment that the small and large EFT (i.e., 1 to 8 size differential) could not be considered interchangeable measures of the same thing. A significant size effect was found in the EFT with: 1) all subjects becoming more field-independent and 2) the performances of the field-dependent and field-independent subjects (as measured by the small EFT) on the large EFT becoming indistinguishable from each other. Furthermore, a significant interaction between the field-dependency and the stimulus-size factor was again found. A non-significant Pearson correlation and a non-significant Spearman rank correlation confirmed this lack of association.

The third experiment also indicated that the EFT and the RFT might not be measuring the same thirg. This was somewhat surprising since all subjects were exposed to all conditions in a completely counter-balanced design. First, in the EFT, all subjects became more field-independent as the size of the embedded figures increased from 1 to 8. In the RFT, the same subjects became more field-dependent as the size of the rod-and-frame increased from 1 to about 4.5. The average visual angle of the EFT ranged from about 5^{0} to 40^{0} for the small and large figures, respectively, whereas the visual angle of the RFT ranged from 9^{0} to about 41^{0}.

The interaction pattern of the field-dependency factors and the stimulus-size factors (as defined within each test) also differed between the EFT and the RFT. Although there was a significant interaction in each test, in the EFT, FD subjects became significantly more field-independent whereas FI subjects remained the same, as the size of the stimuli increased. In the RFT, on the other hand, FI and FD subjects both become more field-dependent but to a different degree. If the two tests had measured a common perceptual mechanism called field-dependence-independence (or more generally, perceptual style), then these different patterns of interactions should not have occurred.

An attempt was also made to see if the performances of the FD and FI subjects on the EFT could predict field-dependence-independence *of the same subjects* on the RFT and vice versa. In neither case could the field-dependence factor, nor the interaction between the field-dependency factor and the stimulus-size factor, be predicted from one test to the other test. This conclusion was confirmed by the correlation matrices that were performed when the scores from all the subjects were taken into account.

One final note about experiment 3. The small and large RFTs were the only pair of tests that showed any degree of statistical association. It was therefore concluded that the small and large RFT measured the same thing in spite of the fact that a stimulus-size effect and a field-dependency/stimulus-size interaction was found. A brief glance at the data from RFT FI and FD subjects shows that all subjects became significantly more field-dependent as the size of the stimuli got large. In the EFT, on the other hand, performances of EFT FI and FD subjects moved in opposite directions as the size of the stimuli got larger (see figures 1 and 2).

General Discussion

When the EFT was four times as large as the standard Witkin EFT, then both sizes of the test were shown to be interchangeable measures of field-dependence-independence, or more generally, of perceptual style. However, when the EFT was eight times as large as the standard EFT, then the two sizes of the EFT were not considered interchangeable measures of perceptual style. This claim was supported by both the correlational evidence as well as the interaction patterns of the field-dependence and stimulus-size factors. Performance by the same subjects on the standard EFT correlated significantly with their performance on the EFT which was four times as large. Performance on two EFTs with a size differential of one to eight did not correlate, however. Furthermore, in experiment 1 (1-4 EFT size-differential), the field-dependency and the stimulus-size factors did not interact, but, they did interact significantly in experiments 2 and 3 (i.e., 1-8 EFT size-differential). The correlational calculations took the performances of all subjects into account, whereas the interaction calculations only took the performances of field-dependent (i.e., FD: slowest third) and field-independent (i.e., FI: fastest third) subjects into account. The results from the three experiments can be compared with each other because the performances of the three groups of subjects on the standard (or "small") EFT did not differ significantly from each other. The interaction data, or the mean performances of the FD and FI subjects, can be seen in Figure 1. In all cases, the performances of these two groups of subjects tended towards a common value, although this trend was only significant in experiments 2 and 3.

Figure 1 about here

Witkin believed that FI subjects were more "analytical" than FD subjects because they could "break up" a stimulus field into parts and ignore the peripheral parts. He also believed that field-dependence-independence was a stable psychological characteristic throughout adulthood. Accordingly, the performances of FI subjects ought to remain constant as the size of the embedded figures increased. This was found in experiment 3. If we add the a priori argument that a stimulus-pattern naturally breaks into parts as the stimulus gets larger, then EFT FI subjects ought to become faster as the figures get large. This was not found.

FD subjects, according to Witkin's hypothesis, ought also to perform at a constant EFT level as the size of the embedded figures increases. The data, however, indicated that FD subjects became faster as the size of the stimuli got larger. We could attribute this to the presumption that large visual gestalts perceptually break up of their own accord. However, FD subjects on the RFT became more field-dependent as the size of the frame increased.

The second major finding of these experiments was that the Embedded-Figures-Test (EFT) and the Rod-and-Frame-Test (RFT) might not have measured a common variable called field-dependence-independence, or more generally, perceptual style. Here again, this conclusion was indicated by the correlational calculations of the data from all subjects and the field-dependence x stimulus-size interaction data from FD and FI subjects. Even though all subjects in experiment 3 were exposed to all sizes of the EFT and the RFT in a completely counter-balanced design, only their performances on the small and the large RFT correlated to any significant degree. All other correlations were low and non-significant. This conclusion was supported by the finding that the performance of FD and FI subjects as defined by one test was not distinguishable to any significant degree on the other test. Finally, the interaction patterns of the field-dependency and stimulus-size factors differed for the same subjects on the two tests. (see figures 1 and 2).

Figure 2 about here

Most significant was the performance-changes of FD subjects. In the EFT, FD subjects became significantly more field-independent, whereas in the RFT, FD subjects became significantly more field-dependent. If the two tests tapped a common perceptual mechanism, then the performance of subjects most susceptible to that mechanism should not have changed in opposite directions as the size of the stimuli increased by a factor of eight. The stimulus-size effect in the RFT has been tentatively explained by the "two-visual systems" hypothesis (Ebenholtz, 1977).

Implications of the Present Findings for Educational Technology Research. The figure-size effect in the EFT for FD and FI subjects (and the non-significant correlations between the EFT and RFT scores in the present study) have a number of direct and practical implications for instructional designers who use visuals, and, for educational technology researchers who use the perceptual and cognitive styles constructs. The trend of the EFT data clearly showed that the mean scores of EFT FD and FI subjects did not differ significantly from each other when the mean visual angle of the figures was about 37^{o} (see Figure 1). Visual supplantation techniques that are specifically designed to compensate for the reduced disembedding abilities of FD subjects are, therefore, not needed when large visual figures are used in instruction. Large visual figures are most likely to occur in large-screen slide-tape shows and in large-screen video formats. Supplantation techniques would nevertheless be useful for increasing the information processing performance of all subjects. The latter supplantation techniques are not necessarily equivalent to those designed to aid FD subjects, and, would have to be determined by further research. In one sense, instructional treatments that use large visual figures do not "discriminate" against the "field-dependence" of FD subjects. Of course, such "equal" instructional treatment would take place at the expense of FI subjects (i.e., their reduced disembedding speeds with large figures). The experiments in the present study were equivocal about whether all subjects improved, or remained the same, in their disembedding abilities (i.e., experiments 3 and 2 respectively) as the size of visual figures got larger.

The figure-size effect in the EFT also implies that the concept of perceptual style might only be useful for instructional designers who create small pictures to aid learning. Small visual figures were defined in the present study to have a visual angle between 2.4^{o} and 6.6^{o}. This size of visual figures is most appropriate for textbook and printed illustrations. In any case, it is clear from the present study that the concept of perceptual style is only useful when the size of the figures used to measure perceptual style (i.e., in the EFT) matches the size of the figures used in the instructional treatment. Most of the educational research reviewed in the present study, which used the EFT as a measure of perceptual style (i.e., small figures), did not control for figure-size in the instructional treatment (Ausburn & Ausburn, 1978).

The non-significant correlations between the EFT and the RFT scores in the present study imply that the EFT and the RFT are not interchangeable measures of perceptual style. The size dimension, which was a common and integral characteristic of the stimuli in both tests, should not have produced such diametrically opposite interactions with field-dependence if both tests had tapped the same perceptual mechanism. Witkin has argued that a common "structure" in the EFT and the RFT supported the interchangeability of these tests as measures of perceptual style (Witkin et al., 1971). The present correlational and experimental evidence, however, supported a different conclusion.

Since the results of the present study indicate the non-interchangeability of the EFT and the RFT, what use are these two tests for educational technology researchers? Investigators who wish to use the concept of perceptual style in their research on learning from small pictures might be well advised to use the EFT, rather than the RFT, as a measure of field-dependence because the stimulus task requirements in the EFT match the information processing requirements of visual pictures. Perceptual tests which tap other aspects of the information processing requirements, such as Guilford's tests for figural adaptive flexibility, gestalt-completion, and perceptual speed (Guilford, 1967), could then be used to complement the EFT in a more robust attempt to understand how human beings learn from pictures.

The RFT is useful for educational technology researchers as a diagnostic tool in those areas where it correlates with learning and teaching styles (e.g., learning social information, the effects of reinforcement, and the use of mediators in learning) (Witkin et al., 1977). Witkin's concept of perceptual style is not essential in those areas where independent correlations between learning and RFT performance exist. The RFT retains its attractiveness as a diagnostic tool because it is such a simple and reliable laboratory procedure and because it is free of symbolic associations. In each of these areas, however, researchers would be well advised to use a large RFT apparatus (i.e., mean visual angle about 37°) because a large RFT discriminates FD subjects from FI subjects better than a small RFT.

END NOTES

1. The different surface areas of the two rods-and-frames is a potential confound in the present study. A stimulus surface-area effect has been found in the periphery of the retina for induced circular vection (Leibowitz & Post, 1981).

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TABLE I

Mean EFT Response Times (RTs) for All Subjects (Ss) in Experiment 1

Size EFT	Ss	n	Mean (secs)	St. Dev. (secs)[a]
Small	Total	16	45.4	27.5
	Male	8	36.2	27.8
	Female	8	54.6	25.6
Medium	Total	16	37.4	26.5
	Male	8	27.0	13.7
	Female	8	47.7	32.8

[a] Standard deviations of samples based on df=n-1.

TABLE 2

Mean EFT RTs for the EFT FI & FD Groups in Experiment 1

Perceptual Style[a]	Size EFT	n	Mean (secs)	St. Dev. (secs)[b]
EFT "FI"	Small	5	15.5	10.7
	Medium	5	26.3	11.6
EFT "FD"	Small	5	78.0	15.0
	Medium	5	65.3	27.0

[a] EFT field-dependence (i.e., perceptual style) defined by performance on the small EFT.

[b] Standard deviations of samples based on df=n-1.

TABLE 3

Mean EFT Response Times (RTs) for All Subjects (Ss)
in Experiment 2

Size EFT	Ss	n	Mean (secs)	St. Dev. (secs)[a]
Small	Total	24	43.1	25.4
	Males	12	29.3	19.0
	Females	12	56.9	23.9
Large	Total	24	46.4	28.7
	Males	12	32.6	20.0
	Females	12	60.3	30.0

[a] Standard deviation of samples based on df=n-1.

TABLE 4

Mean EFT RTs for the EFT FI & FD Groups in Experiment 2

Perceptual Style[a]	Size EFT	n	Mean (secs)	St. Dev. (secs)[b]
EFT "FI"	Small	8	16.2	9.3
	Large	8	45.8	31.4
EFT "FD"	Small	8	70.2	18.1
	Large	8	54.5	32.4

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[a] EFT field-dependence (i.e., perceptual style) defined by performance on the small EFT.

[b] Standard deviations of samples based on df=n-1.

TABLE 5

Mean EFT Response Times (RTs) for all Subjects (Ss) in Experiment 3

Size EFT	Ss	n	Mean (secs)	St. Dev. (secs)[a]
Small	Total	32	43.4	23.5
	Males	16	46.3	25.9
	Females	16	40.6	21.2
Large	Total	32	31.2	19.2
	Males	16	31.7	21.1
	Females	16	30.7	17.7

[a] Standard deviations of samples based on df=n-1.

TABLE 6

Mean EFT RTs for the EFT FI & FD Groups in Experiment 3

Perceptual Style[a]	Size EFT	*n*	Mean (secs)	St. Dev. (secs)[b]
EFT "FI"	Small	11	20.3	8.7
	Large	11	27.8	17.8
EFT "FD"	Small	11	70.0	15.5
	Large	11	28.3	18.9

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[a] EFT field-dependence (i.e., perceptual style) defined by performance on the small EFT.

[b] Standard deviations of samples based on df=n-1.

TABLE 7

Mean RFT Scores for All Subjects (Ss) in Experiment 3

Size RFT	Ss	n	Mean(degs)	St. Dev.(degs)[a]
Small	Total	32	1.50	1.54
	Males	16	1.47	1.44
	Females	16	1.53	1.67
Large	Total	32	4.98	2.60
	Males	16	4.95	2.82
	Females	16	5.02	2.53

[a] Standard deviation of samples based on df=n-1.

TABLE 8

Mean RFT Scores for the RFT FI & FD Groups in Experiment 3

Perceptual Style[a]	Size RFT	*n*	Mean (degs)	St. Dev. (degs)[b]
RFT "FI"	Small	11	.66	1.06
	Large	11	2.59	0.80
RFT "FD"	Small	11	1.52	1.27
	Large	11	8.00	1.95

[a] RFT field-dependence (i.e., perceptual style) defined by performance on the *large* RFT.

[b] Standard deviations of samples based on df=n-1.

TABLE 9

Pearson Correlation Matrices
of the EFT and RFT Data in Experiment 3

Test:	Large EFT	Small RFT	Large RFT
	(a) Total Group (n=32)		
Small EFT	.1231	-.0291	-.0416
Large EFT		-.0828	.0766
Small RFT			.1917
	(b) Males (n=16)		
Small EFT	.2252	.2258	.0347
Large EFT		-.0758	.1753
Small RFT			-.0322
	(c) Females (n=16)		
Small EFT	-.0307	-.2931	-.1426
Large EFT		-.0913	-.0532
Small RFT			.4088

Note. each of these correlation coefficients failed to reach significance (i.e., $\alpha < .05$)

TABLE 10

Spearman Rank Correlation Matrices of the EFT and RFT Data in Experiment 3

Test:	Large EFT	Small RFT	Large RFT
	(a) Total Group (n=32)		
Small EFT	.0695	-.0415	-.1478
Large EFT		-.0455	.1010
Small RFT			.3222*
	(b) Males (n=16)		
Small EFT	.2118	.2537	-.0059
Large EFT		-.0944	.1990
Small RFT			.1234
	(c) Females (n=16)		
Small EFT	-.1324	-.3299	-.2356
Large EFT		-.0707	.0074
Small RFT			.4757*

*p<.05, all others were not significant

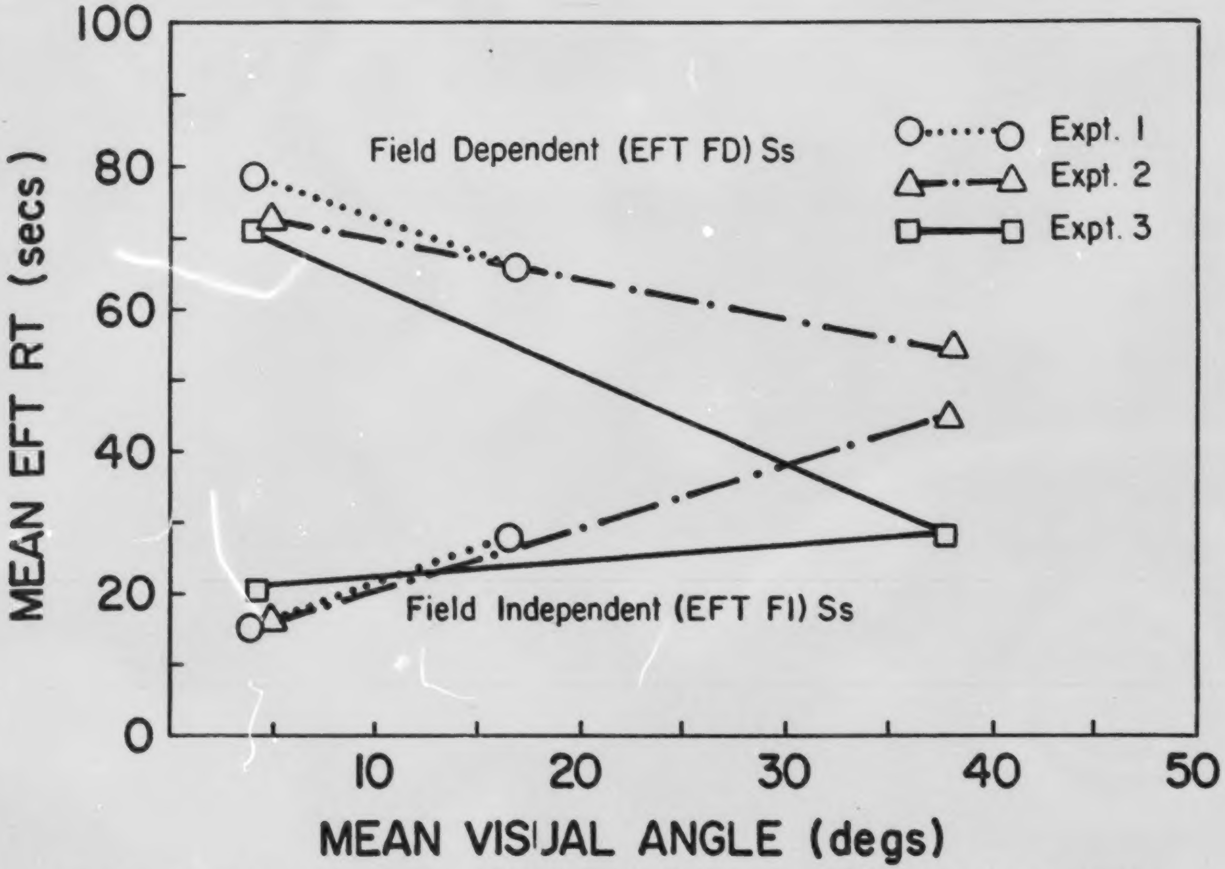

Figure I. Embedded-Figures-Test (EFT) Means for EFT FI & FD Subjects in Experiments I-3.

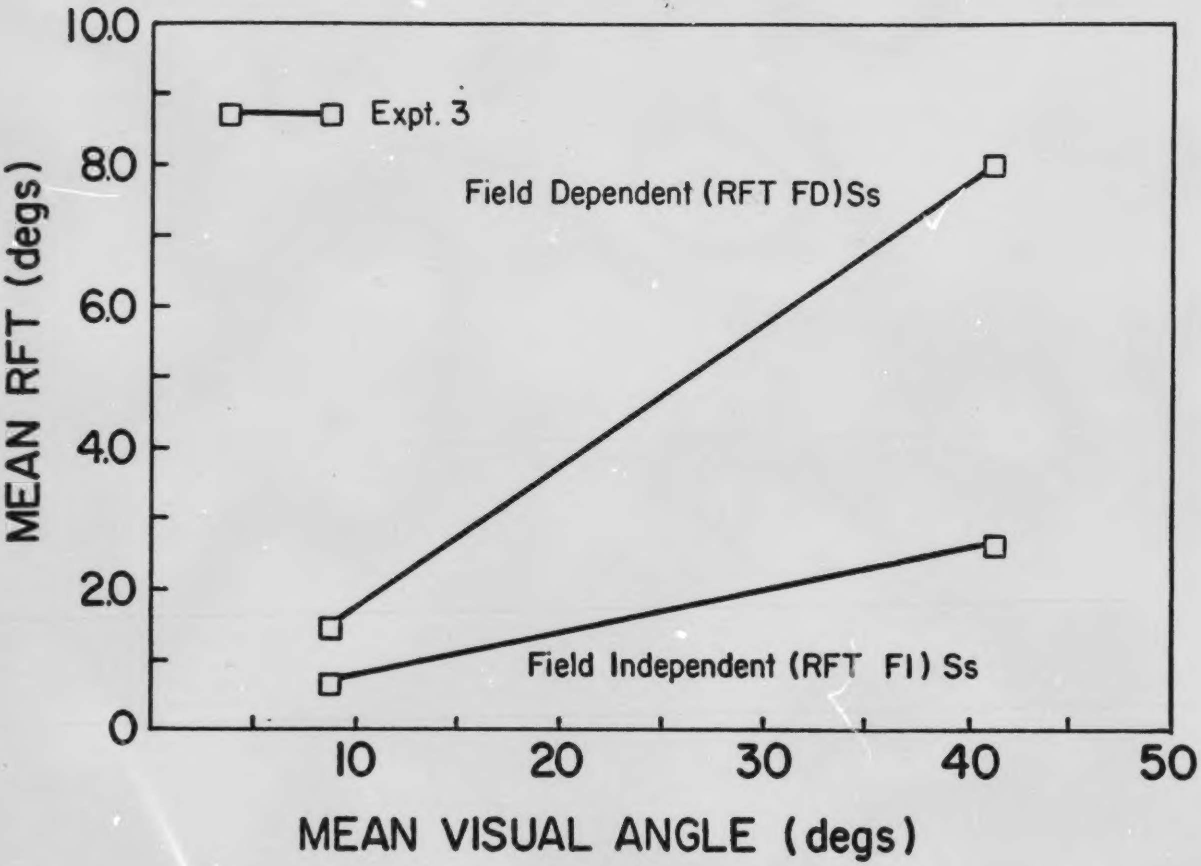

Figure 2. Rod-and-Frame-Test (RFT) Means for RFT FI & FD Subjects in Experiment 3.

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TITLE: Media Research, Past, Present, Future

AUTHOR: Dr. G.M. Torkelson

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"MEDIA RESEARCH, PAST, PRESENT, FUTURE" - Tues, April 7, 10:30-11:45

by

Dr. G.M. Torkelson
Professor of Education
University of Washington

Having come in my early days from the discipline of the social sciences, I have never quite shaken the need to place what is done in schooling and in media research in a philosophical, social context. Consequently, it appears to me that if we do not examine the ultimate goals and effects of our research in light of its users, their needs and characteristics and the milieu in which they operate, then we may be engaging in studies which on one hand are neatly controlled experimentally but perhaps inconsequential in terms of real effects upon educational practice.

To refresh my memory about past events I looked again at the twenty-five year summary of AVCR which it was my pleasure and pain to prepare. Those articles across the years of AVCR which evaluated the results of research usually concluded with discouraging comments about non-significance. Let me quote a few brief statements in passing.

In 1958, speaking of research on radio and motion pictures in education, Hoban said that"...In historical perspective, much of this effort appears to have been wasted."

In 1959, Bill Allen determined that while educational media can teach factual information, "...Not enough information is at hand to tell in what ways each of these media is unique as a teaching tool and what their comparative effectiveness would be in teaching....The translation of research and theory into real-life applications is desperately needed.

Slightly more than a decade later, Allen said that"...the time is far off, if in fact it ever arrives, when we can identify an instructional problem and then faultlessly select the proper instructional mix to solve it."

Even more recently, in 1975, Allen concluded that:

> ...There is little definitive evidence from the aptitude treatment interaction research that...might guide the selection of more general instructional strategies, much less lead to the design of specific instructional media. The research results are so fragmentary and diverse that generalizations from these alone are virtually impossible.

Similar remarks have been made by others.

In 1962 Gilpin concluded that "...programmed learning has not paid off with cumulative and systematic progress which it seemed to promise.

In 1967, Severin claimed that most of the reviews of research in cue summation related to multichannel media indicated mixed and contradictory results.

In the same year Smith and colleagues found that there were no guidelines for determining what aspects of a subject should be assigned to what medium.

In 1968, Hsia said that "...the one conclusion that can be drawn from nearly a thousand studies (of channel effectiveness is that) no generally conclusive statement can be made.

In the same year, Snow and Salomon wrote about the relationships of learner aptitudes to the usefulness of media. They determined that "...virtually nothing is known about the teaching effectiveness of media."

A year earlier, Stickell found only ten out of 250 research studies in television and film that met rigid criteria of research acceptability. Among the ten there were no significant differences.

In 1974 Campeau reviewed research in which media were used to teach adults. She found no valid, dependable guidelines for making choices on the basis of instructional effectiveness.

To counteract these rather pessimistic reviews, suggestions have been made for research improvement.

1961 - Postman: audiovisual education does not call for the formulation of special principles; it calls for the application and elaboration of the general laws of human learning.

1968 - Salomon and Snow: one should expect interaction effects between media attributes, learner traits, and learning objectives, rather than to media attributes alone.

1970 - Gropper: active responding (is) a necessary condition for learning... learning can be heightened by the systematic organization of stimulus materials that control such practice.

1972 - Bauer: investigators in instructional media may need to consider the sense impression response as a plausible criterion for their studies.

1972 - Anderson: the relationships of visual television communication techniques to theoretical models of perception and learning should be investigated more thoroughly than in the past.

1975 - Di Vesta: the next logical step in trait-treatment interaction is to consider the cognitive processes assumed to be correlated with traits and/or the processes induced by the treatments.

In 1975, and again in a recent book, Salomon offered several assumptions about the relationships of media to cognitive processes which I think epitomize current interests:

1. ...codes which serve for communications purposes serve also for covert mediational ones.

2. external communicational codes can be incorporated or internalized to serve presentational purposes.

3. codes, once internalized, can be generalized from their original contexts and can thus serve as schemes of thought.

It is apparent that part of the problem of obtaining clearly defined differences in much of media research has been due to unaccounted factors which may have had effects equal to or larger than the experimental variables themselves. Part of the problem also, in the eyes of constructionists, has been the reductionist approach to research where the argument is that when behavior has been reduced and understood at an appropriately elementary level, then more complex behavior may be understood by combining well-understood fundamental parts. This latter position would be disputed by those who contend that for too long we have ignored the elaborate nature of the individual and the effects of the social milieu as these have influenced responses to stimulus situations. For example, almost twenty five years ago Ray Carpenter was advocating such a position.

> ...It can be assumed reasonably that teaching materials are effective in an ordered manner depending on the degrees of their personal relevance to individual students. ...What is presented to students and what is accepted and learned by them are very different....selective processes are operative at all levels of human experience and at all stages of the communicative processes among individuals....The organism or individual interposes its entire relevant life history between the stimulus material and his or her response.

A recognition of these complications since the time of Carpenter's statement is evident in current concentrations upon the interactive effects of cognitive processes and media attributes. We in general have discarded gross comparisons. We have developed sophisticated theories about media as symbol systems and as variant entities, with meanings subject to individual differences. We have immersed ourselves in the peculiarities of brain hemispheres and have had verbalized, through the Proster theory of learning, for example, that the brain imposes its own structure and experiences upon its environment, with important implications for instructional practice. Yet, in spite of our refinements, we still run into problems.

Is it contradicting our knowledge of human development to use research models which search for constants as predictors of human behavior? For example, in developing aptitude measures of learners for prediction and control have we resolved the conflict of using learner profiles which may reflect only moments in time for judging the behavior of dynamic, changing individuals? Also, where do we acquire the luxury of time and money to do the detailed analyses required to ferret out all the relevant coding units and systems inherent in a given medium as these codes impart information and affect cognitive processes in learners? Are we any closer in our research practices to explaining cause and effect relationships which are valid and not subject to the traditional hedging statement, all things being equal?

In the Fall 1977 issue of the Review of Educational Research (Vol 47, No.4, pp. 654-655), Magoon makes the statement that "...There are some good indications that educational research may have reached a crisis stage with regard to its major Fisherian experimental design tradition, and perhaps that the paradigm has never worked. At any rate schooling, teaching, and learning go on without being explicable via traditional approaches, and serious doubts about methodology have been raised publicly from within the research community." Citing a number of sources, Magoon goes on to say that "Presumed links between particular instructional methods and student achievement have not been found after more than a half century of research." Commenting specifically about trait-treatment interactions, he says further that ".....simple aptitude treatment interactions in school-like settings are very rare and searching for them may well be fruitless....The reason for this state of affairs (and here he cites Cronbach) is not that interactions do not occur, but that there are weak interactions with many things - in fact, usually too many in instructional research. The dilemma is that more complex interactions have a tendency to hide the simpler ones ad infinitium.

Turning to the constructionists for a moment, what position do they take regarding the nature of research and, finally, might we gain insights about the effectiveness of media through some of the procedures of the constructionists?

In the Review of Educational Research, referred to earlier, there is a discussion of the assumptions upon which constructionists base their conceptions of viable research.

One chief assumption about much complex behavior is that the subjects being studied must be considered as knowing beings and that this knowledge has important consequences for how behaviors and actions are interpreted. This position is, according to the author, "...the life-blood of the cognitive proposal, for cognition is literally defined as knowledge or the capacity for it...."

A second assumption is that control over much of intelligent behavior resides within the individual, sometimes constrained by social norms or other circumstances. The implication for research is that learning is best understood as being constructed by teachers and students themselves, requiring that purposes and meanings be taken into consideration if true insights are to be gained.

The third assumption is that evolution has developed the human to a capacity level in three critical areas. One is the ability to develop knowledge by organizing complexity rapidly. A second is that humans generally attend to the deeper meanings of complex communications, rather than simple meanings. And a third is that learners take on complex social roles, a condition which must be known for insights into behavior. For the educational reseracher, therefore, the basic phenomena to be studied, at their most primacy levels, may actually be quite sophisticated and highly organized.

For the researcher in media, it seems to me that the implications of a constructionist approach are quite clear, at least from a methodological point of view. Instead of the reductionist process of isolating variables within a tightly controlled experimental frame, the constructionist would wish to record, through anthropological and sociological means, the situational conditions which impinge upon the uses and interpretations of media. Through the gathering overtime of data through observations, questionnaires, interviews and other relevant data gathering devices, the researcher would look for patterns of responses. Out of such observations would come hypotheses about the relationships among interacting factors. Further testing and refinement of the hypotheses would thus begin to provide some baseline data about the social and human conditions which affect media use. A number of studies have shown, for example, that the presence of and convenient access to a variety of teaching materials does not necessarily result in expanded use by teachers. There are other factors which must be taken into account, such as the constraints on teacher time which prevent thorough involvement in media use, or the very struggle with unruly, unmotivated, defiant students which prevents the act of teaching.

To me it appears important that more time be spent in the domain of the media user, discovering all the factors which impinge upon knowledge of media effectiveness. Perhaps there is not one among us here today who would disagree with the statement that there is a gap between research findings emanating from the laboratory and applications of those findings to educational practice. I would urge a closer study of the values to be derived from both the reductionist and constructionist points of view so that the values of both approaches may help in designing research in media that makes a fundamental difference.

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The Ethnographer-Practitioner Dialectic

AUTHORS: Karen Ann Watson-Gegeo
Abdil Abel Maldonado-Guzman
John J. Gleason

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ESTABLISHING RESEARCH GOALS:
THE EHTNOGRAPHER-PRACTITIONER DIALECTIC

by

Karen Ann Watson-Gegeo
Abdil Abel Maldonado-Guzman
John J. Gleason

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The recent surge of ethnographic studies in education has created a need for better communication about ethnographic methods to media and other technical specialists who may join ethnographers in research teams. Media specialists have usually been trained in non-ethnographic research paradigms, and therefore usually do not share assumptions and procedural approaches with ethnographers. Our paper addresses the nature of ethnographic research and focuses on issues in carrying out research in a field setting, with the aim of aiding media people to understand what ethnography is, what ethnographers do, and how media specialists can be of the most assistance.

To illustrate points in the paper we will be drawing on our own research experiences, which have primarily been in projects aimed at problem-solving; that is, projects whose findings are potentially of use to people in the settings where we have worked, or settings like them.

Whether media specialists are part of the research team from the beginning, or brought into the setting to videotape after the project is underway, they need an understanding of: 1) the goals, methods, assumptions, and processual nature of ethnographic research in general, and the project itself in particular; and of 2) sociopolitical issues in the setting, including relationships established with practitioners and other participants there. For one thing, bringing a media specialist into a setting where research is already underway affects all the relationships that the primary researchers have worked out with the other participants. For another, introducing a machine such as a video recorder into the setting is also likely to have an impact of its own. It is important, therefore, for media specialists to be sensitized to the intricate, continuous negotiation of relationships that accompanies ethnographic research.

A discussion of these points will be taken up later in the paper. We begin by outlining the principal characteristics of ethnographic research.

Ethnography is the descriptive study of a culture (Spradley 1980:3). An ethnography may attempt to describe a whole culture, looking at micro-level behavior to understand macro-level social and cultural processes. Or an ethnography may focus on particular social groups or settings within a larger culture. Our discussion is concerned with ethnography in this second sense, because it is in the study of particular groups and interactional settings that ethnography has gained increasing importance in educational research.

Ethnographic research differs from experimental and quantitative research in several significant ways. First, research questions and hypotheses in both experimental and quantitative designs are predetermined before beginning the research or entering the setting. All variables are controlled except the variable under study. Analytical categories are defined in advance, and often the collected data are reduced to marks on a predetermined coding sheet.

In contrast, ethnographers begin with very flexible research designs and only general questions in mind. They may spend the first several weeks in the field developing research questions appropriate to what is going on there. Because ethnographers are working in naturally-occurring settings, they are unable to control any of the relevant variables, and in fact do not want to control them. Because they are interested in discovering what people actually do and how they create meaning, ethnographers make decisions about which questions and variables are most important to study only after an initial period of observations in the field. And because a primary ethnographic goal is to understand people's behavior and meanings in their own terms, analytic categories are not defined in advance. Instead, categories and coding techniques (where appropriate) are worked out from the data while in the field.

Secondly, experimental researchers construct a laboratory context for the experiment, taking the subject out of his/her normal setting. The laboratory context is treated as a "zero" context--that is, it is assumed not to affect the results of the experiment. Experimental data consist of observations or tests that measure the outcome of the experimenter's intervention--which might be a stimulus, test, or problem presented to the subject.

In contrast, ethnographers enter ongoing settings with the view that the naturally-occurring context is the key to understanding people's behavior and meanings. Thus, rather than ignoring context, ethnographers focus on it. Rather than manipulating people's behavior through a test developed out of theory alien to the setting, ethnographers want to discover what people normally do in their everyday life, how they respond to changing conditions that occur, and how they make sense out of what they are doing. For this reason, the analytic categories developed from ethnographic data reflect the informants' own understandings and interpretations of what is going on.

Ethnographers use a variety of techniques to collect data, but the most fundamental is participant observation. The degree to which ethnographers are participants versus observers varies from situation to situation, and from one time or event in a setting to another. By joining people in their activities as a participant, the ethnographer becomes socialized into the ways people do things and the understandings they have about the world and their own behavior. As an observer, the ethnographer is engaged in looking and listening (Schatzman and Strauss 1973). Besides observing what people actually do and say, the ethnographer interviews them about their behavior--recording what they say they do, why they do it, what they know, and how they make sense out of their own and other people's behavior.

Doing ethnography means being involved in an ongoing dialogue--or more correctly, multilogue--with the people in a setting. Through frequent and intense interaction with informants, the researcher comes as close as possible to achieving an insider's view of the setting, its patterns, and meanings. To accomplish this, ethnographers are constantly engaged in analysis, reviewing and reflecting on their observational field notes, looking for patterns to check out with the people in the setting, and continually reformulating the research questions, hypotheses, and findings. Theory in ethnography is built out of patterns abstracted from descriptive data. In fact, description is only one aspect of doing ethnography. The more fundamental aim is to arrive at grounded theory which accounts for what is going on in the setting, and makes sense out of the patterns identified in the data. By grounded theory we mean that such theory is based in and derived from the data itself, whether or not also guided by formal or grand theory in the social sciences (Glaser and Strauss 1967).

One way to think about the usefulness of ethnography to educational research is to consider the kinds of questions best answered or only answerable through ethnographic methods. Questions of meaning constitute one set of such questions. Ethnography allows us to explore the meanings shared by people in a group, including the meaning of behavior, events, values, and concepts, and to achieve something akin to an insider's view and understanding of these meanings. As ethnography usually involves at least a year in the field, it also allows us to observe meanings as they develop and change over time.

A second set of questions involves social relationships--how people organize themselves in groups, solve problems, negotiate roles, make decisions, communicate with each other, and develop social rules for behaving and interacting. Thirdly, ethnography is the best way to study questions of child and adult socialization in a setting or within a group, including acquisition of language and culture, and socialization to classroom rules and expectations. Finally, another illustrative set of questions best pursued through ethnographic research is cross-cultural differences in styles of communicating, thinking, and interacting--all of which have important implications for schools and educational policy.

In recent years, the growing sophistication of the electronic media has given ethnographers important new data collecting tools to supplement the ubiquitous pencil and notebook of the traditional anthropologist. Today, ethnographers carrying out linguistic and sociolinguistic research on child language acquistion, language and interaction in the classroom, and related work in educational research rely on audio and video recorders to supplement and extend their data base, and to make possible fine-grained microanalyses of speech, paralanguage, and non-verbal behavior.

Because of the increased complexity of data collection, transcription, and analysis, research is being increasingly conducted by teams whose members have different specialities, skills, and backgrounds. In some cases, the teams consist of researchers who are themselves technically competent in media, and in other cases, of researchers and media specialists. The three of us have worked in research teams exemplifying both of these models.

It is essential for all members of the research team to understand the importance of the relationships negotiated and maintained within the context of the research pursuit. For this reason, we are going to address the following aspects of the researcher-practitioner dialectic:

1) Socio-political issues in the research setting; 2) researcher-practitioner relationships and roles; and 3) the impact of these relationships on data gathering and analysis. We will be drawing on our individual and mutual experiences in several projects: Bilingual Classroom Interaction Project (BDIP) (Maldonado-Guzman);[1] Communicative Competence of Severely Handicapped Children (Gleason); Ethnography of Communication Study of Socialization Project (Watson-Gegeo);[2] Homemaker Research Project (Watson-Gegeo);[3] and Hawaiian Talk Story (Watson-Gegeo).[4]

Socio-political Issues in the Research Setting

Socio-political issues first emerge during the negotiation of entry into the research setting. Researchers are obligated by law to abide by federal guidelines for the protection of human subjects,[5] which include obtaining informed consent. But the kinds of assurances that people in a setting may require before giving informed consent vary greatly from one setting to another, or from one place to another within the same setting. More importantly, requirements within a setting may be contradictory.

In bureaucratic situations, such as when research must be cleared by a national or state government or agency, a local department of education, or administrative levels within a school, officials are concerned about obtaining informed consent statements at all levels, as a protection against legal action by, for instance, teachers or parents of students.[6] Most school administrations require written informed consent from children's parents, yet if administrators strongly back a project and fear that raising it with parents will "stir up trouble," they may wish to avoid formal consent procedures. Watson-Gegeo experienced this in Hawaii. In Gleason's study of children's interactions on a ward for severely, multiply handicapped individuals, although permission had to be granted at several levels,[7] the administrators preferred to give informed consent in locus parentis.

Gatekeepers in an organization or institution are concerned about the possible improper use of data by researchers during and after the project. They may attempt to control negative effects by requesting copies of videotapes or even field notes, in order to review them and ascertain whether or not the researcher is presenting a negative view of the school, department of education, or staff. Maldonado-Guzman reports that this has been experienced by a team of researchers from the University of Massachusetts, Boston, carrying out an ethnographic study of return migrant children in Puerto Rican classrooms.[8] In the Homemaker Research Project and in Gleason's study, gatekeeping officials insisted that they retain control over the videotapes altogether. Gleason was not allowed to remove videotapes from the school premises. Watson-Gegeo's team was allowed to analyze the videotapes at Harvard, but duplicates were not to be made, and the originals had to be returned to the Department of Public Welfare at the end of the study. Some countries, such as the Solomon Islands, require that duplicate copies of all taped and written material be deposited with the government prior to the researcher's departure; this practice reflects the growing concern of Third World nations over the removal of data from the control of those who served as subjects of study, with the resulting lack of access for local researchers.

But such policies create a double-bind for the researcher as well as for others in the setting who must give informed consent. For example, giving copies of videotapes to supervisors or administrators may be in conflict with the interests of teachers, who should be protected from supervisors' evaluations. Because teachers fear that principals or other school authorities could use such videotapes for evaluation, they seek assurances from the researchers that the tapes will not be released without their consent. Thus researchers may find themselves caught between supervisors, who can deny entry, and staff, who must be protected from having data used against them. Researchers must therefore carefully consider the implications of agreeing to turn over primary data to supervisors, administrators, or other officials. An especially graphic illustration occurred in the Homemaker Research Project. During entry negotiations, homemaker/home health aides had been given assurance that only the researchers would view the videotapes of in-depth group interviews. At the end of the project, Watson-Gegeo and her team learned that administrators intended to edit the tapes for use in training the very supervisors under whom the interviewees worked, thereby violating the informed consent agreement with the homemakers. This unexpected turn of events meant lengthy negotiations between the research team and the administrators so as to guarantee that the homemakers would again be approached for consent before the tapes were reviewed.

Even when evaluation by a supervisor is not the issue, turning tapes and field notes over to an authority who may make them available to the public must be thought through carefully by researchers.

Watson-Gegeo and Gegeo's taped interviews with Kwara'ae people in the Solomons is a case in point. They have faced a serious problem in trying to fulfill the requirment that they provide the Solomons government with copies of all tapes, because potentially damaging personal and familial information was recorded in some interviews. A member of the government or community with access to the tapes could easily bring about harm to the informants and their families.

Another potential source of harm to members of the setting may come internally. For example, when researchers and teachers view videotapes together so that teachers' interpretations of events and behaviors can be elicited, there is the danger that the teachers may see disruptive or other negatively sanctioned behavior going on that previously escaped their notice. Here, individual children may be in danger of negative evaluations or disciplinary action by their teachers, based on videotaped data. If showing tapes to teachers is part of the research design, then researchers need to explore teachers' reactions to such situations beforehand. In fact, as our discussion on entry has indicated, a serious attempt at consciousness-raising about the process and goals of the research project, as well as the ethical issues involved, should be undertaken by the researchers with all members of the setting. Researchers should regard this as an obligation on their part, since they are more acutely aware of potential problems that may develop.

Informed consent and assurance issues are not ended when entry negotiations have been completed. As we noted earlier, it is the nature of ethnographic research that changes occur in the research questions as the project develops in the field. As a result, data gathering techniques may also change, as well as the research team's need for access to different persons and places in the setting. Each change means returning to the gatekeepers and participants in the setting to renegotiate informed consent and assurances. Gleason originally negotiated entry to do observations only, but later found that a set of communicative patterns identified by observations needed to be videotaped for microanalysis. Because this was a significant change in his research, he had to develop a new proposal and go through a lengthy negotiating process at several levels in the institution. As researcher, his ethical concerns included the potential impact of videotaping both on ward activities and on members, and the implications of exposing to possible public view the behavior and personal lives of severely handicapped individuals. The institution, which was currently undergoing federal inspection, its program implementation being monitored by the district court, and which had endured public reactions from newspaper accounts of conditions there, regarded its position as sensitive. It finally agreed to allow Gleason to videotape on the condition that the tapes not leave the grounds, and that they remain the property of the school.

Most entry negotiations are complex, requiring permission from a series of individuals at various levels in the decision-making process. Each of these persons not only can deny permission, but also can potentially influence the direction of the research by limiting access or forbidding collection of certain kinds of data. For researchers, then, important ethical and practical consideration is how to explain the nature of the research and the goals of the project in ways that will be clear to gatekeepers and members of the setting. Ultimately, gatekeepers will base their decisions on the degree of trust the researchers have been able to build with them during the negotiating process.

We have found that often research needs to be further legitimized by building relationships with the larger community to which the setting belongs. In the Solomon Islands, Watson-Gegeo and Gegeo have held public meetings for people from a very wide geographical area, even though intensive research was being carried on in only two villages, in order to inform the wider community about the nature of the research and the potential use of it to the district. Maldonado-Guzman felt that members of the school community other than the gatekeepers could ultimately facilitate or not facilitate the research process of the BCIP project. Negating attitudes by the other teachers could have undermined the degree of trust already developed with the two participating teachers. Sensing these problems, Maldonado-Guzman spent time sincerely and clearly explaining the purposes of his research to the participating teachers, explaining findings as they developed. Rather than keeping information away from the research subjects, therefore, it became important for retaining trust to share what was being discovered.

The degree of trust developed between BCIP researchers, the participating Chicano teachers, and the principal, along with the good relationships established with parents and their children, had the effect of making these people advocates of the research in the larger school community. The political situation of the school is that there is a sharp political division between the 42 Anglo and Black teachers and the eight Hispanic teachers, who together teach a student body which is 90 percent Hispanic (mainly Mexican-American) in a school located in the heart of a Mexican-American neighborhood. The Hispanic teachers saw the project as an essential one for promoting bilingual education and perhaps for supporting the fostering of Chicano cultural values in the school. English-speaking teachers were concerned that the project would lead to their jobs being threatened. They feared that the ECIP wanted to prove that bilingual, bicultural teachers (in this case, Hispanic) were doing a better job teaching Hispanic children than they were. They felt especially uneasy, perhaps, because the two on-site researchers were themselves Hispanic. Entry had originally been negotiated by a Hispanic graduate student at Harvard University,[9] who had previously taught at the school. The gatekeeper is the school principal, a Black American with experience in Hispanic communities, and who is married to a Puerto Rican. School officials regarded the association with Harvard as a plus, but Anglo teachers seemed to regard it with sarcasm and indifference. In retrospect, Maldonado-Guzman feels that presentations to the school faculty would have had better reception had they been made by Cazden and Erickson, who are Anglo and well-known authorities, rather than by Carrasco and himself, who are Hispanic doctoral students. Anglo teachers might have felt more willing to trust Anglo researchers with whom they shared ethnic co-membership, and whose status as researchers they could recognize.

The role of the participating Chicano teachers in developing trust among the Anglo and Black teachers in this charged political situation has been very important. In the absence of the researchers, who carry out data analysis at Harvard and Michigan, the participating teachers continue to explain the project to their colleagues, argue in its favor, sustain the relationship with the principal, and develop relationships with the Anglo and Black teachers. They have also undertaken other negotiating tasks for the project, including contributing to project presentations to the school faculty, building links between the project, parents, and the larger community outside the school, monitoring the questionnaires distributed to other teachers, and negotiating agreement with Anglo teachers at their school as well as at a second school for classroom videotaping (as part of the Cross-Cultural Ethnographic Study of Bilingual Classrooms project funded by the Ford Foundation, which will extend the work of the BCIP).

Our experience in research suggests that members of the site are often more open to people who they can trust on the basis of co-membership--that is, shared sociocultural or ethnic characteristics (Erickson 1975). Maldonado-Guzman and Carrasco's co-membership with Chicano teachers is a good case. So is Watson-Gegeo and Gegeo's research among the Kwara'ae in the Solomon Islands, where Gegeo is a native speaker of the language and a member of the culture, and Watson-Gegeo has married in. However, co-membership--even that of common ethnicity or kinship--by itself does not guarantee entry or trust. For example, Hispanics frequently regard fellow Hispanics with graduate degrees as having sold out to Anglo perspectives and values, and may deny them access to a research site. Sometimes the mere educational advancement of an ethnic co-member, therefore, is looked upon as a way of leaving or betraying the ethnic community. Gegeo has faced another common problem, of jealousy from friends, relatives and others who resent his rise in status through higher education.

It is important, therefore, that insiders who have been outside for some time re-establish their primary identification as insiders, and approach appropriate people who have key roles in the setting during the negotiating process. The public meetings held by Watson-Gegeo and Gegeo in the Solomons helped to bring this about, as village meetings are the traditional way of obtaining informed consent and initiating a new activity. They have also enlisted the assistance and advice of leading elders in the district, by forming a committee to participate in the research. Gegeo has gone to great lengths to show how the research will benefit people locally, and to demonstrate that his primary loyalty is still to his own village. Watson-Gegeo has shown her willingness to become an insider by taking up the cutlurally appropriate roles for married Kwara'ae women.

In some settings, the history of political and economic conflicts, competition, or ethnocentrism among groups may prevent entry by researchers of particular ethnic identities. For example, the racial situation in the United States and the socio-economic status of minorities sometimes mitigates against Anglo researchers in minority communities. Clem Adelman and Saville Kurshner, British researchers who have conducted a study of racial attitudes in a Black school in Boston over the past two years, report that they felt they had little problem gaining entry to the school because they are British.[10] They argue that had they been American, access would have been difficult to gain because Blacks would have felt threatened by speaking openly about racism to whites who they perceived as parties themselves to the racial conflict. Similarly, Maldonado-Guzman has found that Puerto Rican groups and communities in New York are highly suspicious of Anglo researchers.

The examples we have presented so far indicate that negotiating entry for a research project is an ongoing process that continues until the final research report is delivered. All three of us have experienced special problems when returning to a research site after a hiatus of several months,[11] or when the nature of the project itself changed. Establishing good working relationships with people in the setting (discussed below), such that participants can feel a sense of partnership, is an ethical as well as practical way to keep the netotiating process open.

Finally, another political concern in settings is the disposition of the research findings towards programs and policy. Researchers, people in key power roles in the research site, and practitioners all need to be involved in action and policy resulting from a research report, in order to insure that findings are appropriately used. Often the goals and outcomes of research are distorted or totally altered by policy makers who design programs that reflect how detached they are from research sites. Researchers must recognize that with the assurances they give and the trust they build in a site comes an expectation that there will be some concrete response to the needs of the setting through their research. We pose this as a problem research teams need to address, even though we are unable to offer solutions. We are very clear, however, about the outcome of ignoring local needs or of the inappropriate application of research findings. It is increasingly the case today that researchers are denied entry into settings because many communities and institutions feel that outside researchers have exploited them. They are suspicious of research that they do not initiate themselves, or that is not focused directly on local needs. And they are also aware that research that "sounds good" frequently ends up being inappropriately applied or not used at all.

Researcher-Practitioner Relationships and Roles

When researchers enter a setting, such as a classroom, to study what is going on there, they themselves become a part of the social organization for a time. While busily engaged in sorting out how role relationships are played out among people in the setting, the researchers are also engaged, whether consciously or not, in building relationships themselves with the participants in the setting. In fact, a mutual investigation is going on, in which the degree and quality of trust that a setting's participants evolve towards the researchers is being shaped and tested. We have found that trust especially depends on clear, mutual understandings of each person's role, and the rules, rights, and obligations that go with it. Our discussion of researcher-practitioner relationships is organized around the three basic models for researcher-practitioner roles found in social science research today: the researched as subject, the researched as informant, and the researcher and researched as full partners.

The most traditional model for researcher and practitioner roles is that in which the researcher is in complete control of the project, and practitioners or other persons in a setting are viewed as subjects of the research. One result of this model is that all of the methods or investigative procedures used in data collection and all of the interpretations made in data analysis are those of the researcher. Such a model is typical of experimental and quantitative research, but its most extreme form is rare in ethnographic research today; in particular, interpretation of ethnographic data requires enlisting the assistance, feedback, and knowledge of practitioners on a much more equal footing than is implied by this model.

An intermediate model for researcher-practitioner relationships has researcher and practitioner collaborating in various ways throughout the project. Here the practitioner does not play an important role, if any, in research design and selection of method or technical procedures in the research. But he/she does play an important role in suggesting questions and issues to explore as the research evolves; providing the insider's (emic)[12] interpretation of issues, situations, and interactions during data analysis; and developing good public relations for the project in the setting. The practitioner in such a model is an informant whose inside knowledge of the details and meanings in all aspects of daily life at the setting is crucial to the ethnographer's ability to create a comprehensive description and analysis of the data. As informant, the practitioner is a colleague to the researcher, but there is nevertheless a clear distinction between their roles (Florio and Walsh 1976). In particular, it is the researcher who writes the final report, determines how findings are explained, selects what is to be emphasized, and continues representing the findings through professional presentations, lectures, and publications. The practitioner may have veto power over reports or wording in them, and may comment on, object to, or be allowed to modify certain interpretations. Ultimately, however, publication is in the hands of the researcher.

All three of us have conducted our research with variations of the "practitioner as colleague/informant" as the underlying model. When one or two persons in the setting serve as close confidantes, anthropologists refer to their role as key informant(s). For instance, Gleason established a close working relationship with the psychologist at the institution in which he spent two years observing interactions between severely mentally retarded individuals. As a trained observer of behavior with special insight into mental retardation, development, and learning; a a member of the setting who moved in and out of the ward during the week (thereby maintaining an independent perspective); and as one who occupied a position between that of the supervisors and the primary care-takers, the psychologist was in an excellent position to evaluate Gleason's interpretations of the residents' behavior, and gauge their importance. Similarly, the researchers in BCIP developed close working relationships with the two teachers in the classrooms they videotaped. As discussed earlier, the teachers performed public relations and organizational functions for the project at the school, and were involved in data analysis with the researchers. In Watson-Gegeo's classroom experience in Hawaii, she formed colleagueal relationships with the three teachers involved, but her key informants were four six-year-olds, who assisted with taperecording, interpreted events as they occurred when Watson-Gegeo seemed confused, and sometimes translated Pidgin phrases and Hawaiian words into Standard English for her. In the Solomons, Watson-Gegeo and Gegeo have developed key informant relationships with several individuals who are culturally knowledgeable, and who see the work as extending their own educations.

When the researcher and practitioner are colleagues, they also often become friends. Over time, bonds rooted in trust and shared work become very strong. Each may come to feel that they share a deep mutual understanding, a common sense of the important issues, and an open attitude towards exchanging information. But the researcher must judge what levels of sharing the cultural and socio-political situation of the setting permits. On the one hand, a close relationship of concern and trust may allow the practitioner to address issues that in other relational conditions would be avoided. On the other, the informant may avoid issues or obscure information with a view towards protecting the researcher, or their close mutual relationship. Because our research is often action-oriented--directed towards improving practice in some way--we have been especially concerned with helping practitioners to feel self-confident and willing to discuss potentially threatening topics, especially when research findings imply the need for changes in practice. For example, Maldonado-Guzman is currently studying differential treatment of students by their teachers, in the BCIP project. He has found that this issue, normally very difficult to raise with practitioners, has been approachable with the two teachers because of their established trust in the research team, the guarantee of anonymity originally given them, and their own desire to improve their teaching. In fact, the opportunity to learn more about their own teaching has been one incentive in keeping them involved in the project. Maldonado-Guzman has found them willing to undertake probing, unstructured interviews and detailed questionnaires on differential treatment, thereby providing extremely useful complementary data to the videotapes.

For ethical reasons, as well as for the "practitioner as research colleague" model to work well, researchers must be willing to be straightforward about all aspects of their work. As the research develops, therefore, they have an obligation to explain what the research foci are, the sorts of questions and hypotheses being generated, and what the researchers are after. The argument has been made that to become too close to informants, and especially to tell them about the research in detail, is to bias the situation and thereby affect the resulting data. But in our view, practitioners and other informants will always evaluate and reflect on what they see researchers doing. Their close observations will lead them to draw conclusions about what they think the researcher is looking for. If they conclude that the researcher has misled them, their sense of trust in the project will be destroyed, and they may attempt to alter their behavior to sabotage the findings. On the other hand, they may be eager to help the researcher along by altering their behavior so that things come out the way they think the researcher wants them to. It is therefore naive to assume that by obscuring the thrust of the research from practitioners, one is protecting against biasing their behavior. Our experience has been that in an ongoing setting where events are happening rapidly and are complex in nature, such as in the classroom, that although practitioners may attempt to alter their behavior at first when the researcher is present, such biased behaviors are short-lived. The pressure of relationships already established with other members of the setting, as well as the need to maintain continuous interactions, quickly results in people returning to their previous, more natural behavior.

The third model for researcher-researched relationships is the practitioner as full partner in the project: involved as an equal partner from the beginning, from initial planning through the delivery or publication of the final report. This model has been referred to as interactive research, or participatory research (e.g., Cain, in press; Tirkunoff, Ward, and Griffin 1979). One possible goal of this model is to put research tools and skills into the hands of practitioners or members of communities themselves, so that they can conduct research on their own after the project is completed. Another is to demystify the research process, and to remove the status differences between researcher and researched. Still another is to guarantee that a research project will take the direction that people in a setting want, so that their issues and problems will be addressed. This model developed out of ethical and practical considerations associated with research and development projects, and action research.

Watson-Gegeo was involved in a project following this model during her tenure at the East-West Center in Honolulu. The East-West Center, a federally-funded educational institution mandated to carry out projects that promote better relations between countries in Asia, the Pacific, and North America, requires all projects to be carried out by international teams. Watson-Gegeo found that in practice, this often meant that researchers from the Center designed the project with minimal input from Asian or Pacific colleagues because of the problems of international communication, and often because foreign governments were unable to free experienced researchers from their other duties to begin new projects. In a sociolinguistics project she co-coordinated (on behalf of the Center), eight countries in Southeast Asia had assigned, as principal investigators for their area, young scholars who were trained in linguistics but not sociolinguistics.[13] Watson-Gegeo and co-coordinator P. W. J. Nababan found that the full participation of these principal investigators was facilitated by providing an intensive eight-week workshop in sociolinguistics for them, focused around the intended goals of the project. We feel that this experience indicates some of the complexities of interactive research, including the need for very careful planning and appropriate training if practitioners or other participants are to have a truly equal relationship with researchers.

As suggested earlier, the researcher-practitioner relationship may also be affected by co-membership, that is, shared cultural, ethnic, geographical, class, professional or other group identities. Maldonado-Guzman and Carrasco found that their Hispanic ethnicity, as well as the commitment to bilingual/bicultural education they shared with the focal Hispanic teachers of the BCIP project, were central to the strong sense of trust and community that developed among them. Teachers or other professionals often express that they are more likely to give credence to a research effort in which the researchers have had practical experience in the very activities they are studying. Both Maldonado-Guzman and Carrasco had classroom teaching experience before the BCIP began. Gleason had broad professional experience in special education prior to undertaking his study of residents' interactions on the ward for severely retarded individuals. Professional co-membership is important to giving practitioners assurance that the researchers will understand the problems practitioners face in their work, and the perspectives, methods, and techniques they employ based on their training and experience.

We turn now to some general aspects of the researcher-practitioner relationship, before looking at interactions within the research team itself. A researcher entering any setting must ask, "How should I conduct myself as a partner in this setting? How should I carry out the research, and show respect for the roles and relationships already ongoing?"

Whatever the researcher-practitioner relationship model, we have found that the following four characteristics of reciprocity need to be clearly stated and agreed to by the researchers and members of the setting, both for the sake of fairness to each side, and for the quality of the research.

First, the researcher has an obligation to the practitioners or other participants in the setting to be as unobtrusive as possible in data-gathering, such as tape or video recording. This means consulting with participants before selecting places from which to record, so as to not interrupt the regular flow of activities there, or be in the line of traffic.

Secondly, there must be an understanding by all that the researcher will cooperate with the teacher or other practitioners in the everyday life of the setting, and will maintain good relations with all of the participants. For example, children should be treated as participants and not as subjects. By cooperating in the everyday life of the setting, we mean not getting in the way, not interrupting when, for example, a lesson is going on in the classroom, agreeing to move or change activities if the practitioner requires, and in general, respecting the fact that most settings are workplaces for the participants. We also mean that researchers should assist in useful ways that do not cause a major disruption of the research. For example, we have all done favors for the teachers or schools in which we were carrying out research, such as helping to carry equipment or even lending equipment, going along on field trips as an adult monitor, helping teachers give a party for the class, cleaning up the room after school, and assisting children with their lessons--or tying their shoes.

Thirdly, the researchers need to be sure that in a long-term project, relationships are maintained by regular visits to the site. Visits and talks with other participants who may not be direcly involved in the research are important, too, as Maldonado-Guzman has found. In this way, the participants in the research, the school officials, and others can be kept abreast of the direction and evolution of the project, as well as be reassured that the researchers have a continuing genuine interest in the setting. When on the site to collect data, researchers should be willing to socialize outside of the setting with the participants; getting to know participants well helps both sides to feel more natural and familiar with each other in the setting.

Fourth, participants' time spent in the project must be reimbursed in some way. In Watson-Gegeo and Gegeo's work in the Solomons, primary reimbursement is made in the form of money, and gifts of food, tobacco, household goods, or cloth. But reimbursement can be made in other ways. In the BCIP project, reimbursement has been made in several ways: workshops for teachers to explain the process and results of the research; participation by teachers in professional conferences and university seminars, for their professional enrichment; and cash reimbursement to teachers for time spent answering questionnaires. The BCIP has also obtained instructional games, guides for teaching bilingual classes, books, and even purchased Mexican pastries for the children in the school. Watson-Gegeo and Gegeo have offered village lectures and conferences on aspects of their work, such as Xwara'ae phonology, and plan a series of village lectures on health care when they return to the field next year, in response to people's requests for some kind of adult education program.

So far we have taken "researcher-practitioner relationships" to refer to relationships between the research team and practitioners (such as teachers) in the setting. Now we want to focus briefly on relationships within the research team, between researchers and the media specialist as practitioner. We have argued that when a media specialist is brought into a setting to videotape, it is essential that he/she understand the overall nature of ethnographic research, as well as the specific goals and questions of the immediate project. One problem that Gleason and Watson-Gegeo (in the Homemaker Research project) have experienced is that media specialists have often been trained in particular non-ethnographic methods of taping, and in some cases, in artistic modes of using the camera and editing tape. They may not be sensitive to the needs of ethnographic research, or to the subtle kinds of interactional sequences ethnographers are looking for.

For example, after he identified a play sequence in which two residents on the ward exchanged a toy, Gleason decided to have a videotape made to facilitate detailed analysis. Media specialists at the school were called in, because Gleason felt that if he operated the camera himself, he might bias the focus on particular events or sequences of interaction. He assumed that if the media specialists arranged the camera, they would conduct the taping with the least bias and the best technical results. Gleason specified that the camera should be placed at one end of the ward, and allowed to run in order to capture the spontaneous events occurring among the residents. But the media specialists were accustomed to filming a population with higher abilities, in diagnostic prescriptive settings. They expected that a toy when given to a child would be played with immediately. When this did not happen, the media specialists took the toy away and handed it to another child, thinking that this would help initiate interaction. As a result, there are no scenes on the tape when the camera was left focused long enough on a particular child with a toy to replicate the events of play documented in Gleason's field notes. Despite Gleason's original careful explanation, the media specialists could not adjust their time frame and expectations to the long period required for a severely handicapped child to initiate interaction with the toy. Further, the media specialists had difficulty accepting the fact that what Gleason wanted to capture on tape went on during rest period, while the teachers were not present. They assumed that nothing would go on, and when play events did not immediately occur at the beginning of the taping, they grew restless. As a result, what they did tape confirmed their initial expectations that these residents "did not do anything." Gleason realized in retrospect that the media specialist and researcher must have a clear understanding of one another's assumptions prior to taping. In this case, the misunderstandings became evident only after viewing the first tape. Modification of subsequent recording sessions could presumably rectify the situation, and clarify the assumptions.

Data Gathering and Analysis

Relationships within the research team, and between the researchers and the setting's participants have an important impact on data gathering, as we have indicated. Earlier we pointed out that the quality and nature of the data collected is dependent on relationships the researcher has built with participants, including how the focus and purpose of the investigation is represented to them. To emphasize this latter point here, we want to return to Gleason's videotaping efforts discussed above.

Gleason had explained to the psychologist and the attendants on the ward that the taping session was to be conducted during a normal rest time, with the equipment introduced as unobtrusively as possible. But the resulting tapes revealed very different conditions. The mats on which residents usually played or rested had been repositioned. The attendants had cleaned up the residents and changed their clothes, which was not a routine practice for that time of day. Residents had been selectively positioned near one another, something which never happened during rest period. In fact, during a normal rest period the residents are separated and told to be quiet. Moreover, selected toys had been placed near or beside them--namely, the toys Gleason had earlier identified as favorites of the residents. This was a startling change, because usually residents did not have toys given to them.

Another significant change was that the psychologist and the attendants, along with two cameramen, were all standing or sitting in the background, watching the residents. This must have seemed strange to the residents, who ordinarily were alone during rest periods.

The tape also revealed that rather than allow residents to play or not play spontaneously, the attendants and psychologist attempted to "get things going." On tape, an attendant's hand can be seen adjusting a toy, for example. At one point the psychologist picked up a resident and repositioned him, apparently hoping to initiate an interaction that she and Gleason had both observed earlier. The boy was startled at being moved, and made no attempt to interact; he sporadically swung the toy--which had been given to him. The type and quality of the behavior Gleason had expected to capture on videotape was lost due to the many disturbances in the routine caused by the videotaping session, which seemed to quell the residents' initiative.

Gleason realized later that he had failed to communicate the fundamental shift in his own way of looking at what the residents were doing, and the implications that this shift held for data gathering. That shift involved the time frame in which residents initiated and completed play sequences with each other. Because a single play sequence, such as the patterned exchange of a toy between two individuals, required more than an hour to occur, and took place in phases separated by long intervals, onlookers not accustomed to the intensive observation Gleason had carried out over long periods quickly concluded that nothing was going on.

Gleason's experience underlines the value of closer relationships between the researcher and setting participants, as well as the need for researchers to cooperate with participants in developing strategies for controlling for videotaping-related variables that upset or disturb the very everyday routine the researcher wishes to record.

In Gleason's case, the residents he wanted to videotape were disturbed by the changes made in their everyday routine by attendants, the psychologist, and the media specialists; their behavior was not biased by knowledge of what a camera is or what being recorded implies. In classroom situations, however, children do at first react to the presence of a video camera or tape recorder by playing to the camera--mugging, gestures, and other acting out behavior, for example, is seen on the first few tapes in the classroom made by the BCIP. Watson-Gegeo experienced the same kinds of reactions among the Hawaiian children she was tape recording. Adults may at first either fear a microphone or camera, or play to it, too. How, then, can ethnographers get natural data when using electronic media in research settings?

We have found trust and familiarity are important factors in helping participants not to be distressed or disturbed by recording. Trust relationships mitigate against participants seeing the camera or microphone as threatening. Equally important is becoming habituated to the presence of the researchers and the equipment in the setting. When participants feel confidence in the project, and are familiar and comfortable with the presence of researchers, they soon come to ignore the equipment and resume being themselves in their everyday life. As a control for the early effects of recording, ethnographic researchers normally expect to discard or set aside the first tapes made in a situation if they show biased effects.

In an ethnographic project, data collection and data analysis go on simultaneously while the researcher is in the field. Because ethnography is a generative process, researchers are engaged in continuous analysis from the beginning of entry negotiations. Spradley (1980) points to the cyclic nature of ethnography: the ethnographer enters a setting, observes and asks questions, writes down accounts of the observations and statements of participants into a record, analyzes and reflects on the data, comes up with new questions or new refinements of the same questions, goes back into the setting for more data collecting, and so on. A major task of ethnography is learning to ask the right questions, that is, the questions that make sense of the data in all its contextual complexity.

The simultaneity of data collection and analysis in an ethnographic project makes it possible for participants in a setting to help the researcher formulate questions and interpretations. A primary goal of ethnography, as we have mentioned above, is to achieve something close to an emic understanding of events and behavior in a setting--that is, an insider's perspective on the rules, meanings, and modes of interpreting behavior that participants in a setting share. One way is continuous informal meetings with practitioners (as in the BCIP project), and frequent and focused conversations with setting participants (which we have all done). Any informal situation may serve as a context for such discussions. Another way to help bring about a convergence of the etic perspectives of the researcher with the emic perspectives of the participants is to review data together. Maldonado-Guzman and his colleagues have held videotape viewing sessions with the BCIP teachers, for example. Viewing sessions with the teachers are used to expand the audio-visual record of the videotape. By expansion, we mean that the teachers can fill in background information about participants on the tape, reflect on their own motives and intentions in an interaction, give a history of the interaction prior to the beginning of the tape, explain how they interpreted what was happening at the time, and reflect on the meaning of their own and others' behavior. This mode of data analysis brings important new information to the researcher not usually available, since people's recall of interactions are usually insufficient for microanalysis.[14]

An important function of viewing videotapes together may be to correct the researcher's misinterpretations of events. In one viewing session with the BCIP teachers, Maldonado-Guzman asked one of them why she had been so unfair to a child by asking him to go to the back of the room, rather than allowing him to work with his mother (an aide in the classroom), who was assisting a group of students. His choice of the word "unfair" showed that he had automatically evaluated the teacher's conduct according to his own values, based on what could be seen on the tape. The teacher replied, "Dammit, didn't you see what he was doing?" She then explained that the child had been interfering in her work with the group, out of the camera's view, by marking up the booklet that the teacher was using to guide a reading lesson.

The example just discussed involves an insider's perspective when the outside observer's view is in some way obstructed. In this sense, the teacher was clarifying the actual event that took place for the observer, who was not physically in a position to see the event accurately.

But there is another more important sense in which the insider's perspective must be obtained. It would be possible to write a descriptive account of a setting and the activities that go on in it without eliciting the participants' own background understandings or interpretations of what occurred. Such an acount, however, would not be ethnographic because it would fail to explore the participants' emic levels of understanding--shared knowledge of interactional rules, of procedures for interpreting behavior and events, and the assumptions and expectations with which they approach events in the setting. Ultimately the ethnographer will base the final etic analysis on emic concepts and categories discovered in the field.

However, the problem for "insider" members of settings is that much of their cultural knowledge is tacit and therefore taken for granted. For example, social rules for how close two people stand together when conversing, how to behave properly as a student in the classroom, or ways of nonverbally showing approval of a child's behavior are taken for granted by co-members of a cultural group or setting. People assume that everyone behaves as they do, and when asked may find it hard to explain the patterns and rules that researchers find interesting. This problem exists for co-member researchers as well as for setting participants not trained in research. For example, Maldonado-Guzman and Carrasco have been surprised to find that in analyzing the Chicago classroom tapes, they often overlook patterns in behavior that intrigue Cazden and Erickson. As cultural insiders, they are so accustomed to Hispanic styles of behavior that they themselves take many patterns for granted, or fail to recognize certain behaviors as patterned. The BCIP research team of two Hispanic and two Anglo researchers has therefore proved to be a very creative and fruitful experience, in which emic and etic perspectives contribute to a much more complete analysis than either side might have produced individually.

Watson-Gegeo and Gegeo, as insider and outsider researchers, engage in continuous discussions on theory, method, goals, and outcomes while in the field, and later during final write-up. They have developed a format for discussions that leads to successive expansions of interpretation, leading out from behavioral descriptions of events they have both witnessed, and that respects the perspectives of both points of view.

Even when cultural insiders become consciously aware of patterns that they normally take for granted, they may not think of the patterns as reportable--that is, they may consider them trivial or so obvious as not to be worthy of conversation. Insiders may not realize that outsiders cannot "fill in" the missing relationships or interpretations implied by a phrase, allusion, or partial statement of a rule.

These links have to be made for the outsider if the behavior is to be understood. An example occurred in Watson-Gegeo and Gegeo's Solomons project in 1979. The mother of Gegeo's sister-in-law came to a village feast and gave a formal speech, partly on behalf of her son, a local priest who had frequently visited Watson-Gegeo and Gegeo during the field project. Afterwards, Watson-Gegeo went to shake hands with the woman, because this was their first meeting. As they took each other's hand, the woman said in English, "Father James is my son. Do you know him?" Watson-Gegeo assured her that she did, then returned to where Gegeo was sitting. She reported the woman's exact words to him, and he nodded affirmatively. No more was said about the incident until more than a year later, when the two researchers were working on transcriptions of the speeches given at the feast. At that point, Watson-Gegeo commented in passing that the woman had been kind to try to speak English when it was so difficult for her. Gegeo reacted in surprise, saying that she knew English very well, and questioned why Watson-Gegeo had made such a judgment. It turned out that Watson-Gegeo and Gegeo each had very different interpretations of the interaction. As outsider, Watson-Gegeo thought that the woman was trying to say "Father James is my son. Of course you know him," or "You know him, don't you." But as cultural insider, Gegeo knew that she was using the English word "know" as a Kwara'ae speaker would use its equivalent in Kwara'ae, to mean the special kind of knowing that can only exist between kin, with all of the important cultural implications that go with that. The woman wanted to be sure that Watson-Gegeo knew her son in that way.

These examples point out the need for outside researchers to help raise the consciousness of insiders to what they already know, and to assist them in learning how to call up their cultural knowledge, explore it, and communicate it. Another aspect of ethnographic research shown here is that such research requires a great deal of patience on the part of researchers, and a willingness to return again and again to participants in a setting, to refine their mutual discussions of emic meanings and interpretations. Exploring the researcher's own emic levels, especially when researchers and participants are not co-members, may be a way of helping insiders to make explicit and compare theirs.

Conclusion

Our concern in this paper has been to indicate some of the complexities of doing research in a field site. We feel that all members of a research team must understand the nature of ethnographic research, and the political, relational, and analytic issues that emerge in carrying out long-term research on the everyday activities in a setting. As recording technology becomes increasingly more sophisticated, media personnel will be increasingly involved in research teams. Even when media specialists are to be brought in to videotape or do other work during one component of a project, we feel that they should be involved with the team from the initial stages of planning.

FOOTNOTES

1. The Bilingual Classroom Interaction Project, housed at Harvard University, is funded by the National Institute of Education (1978-1981). Co-principal investigators are Frederick D. Erickson (Michigan State University) and Courtney B. Cazden (Harvard University). With Robert Carrasco, Maldonado-Guzman has been a primary researcher in the project, and Watson-Gegeo has served as consultant in sociolinguistics. Data collection has taken place in Chicago.
2. The Ethnography of Communication Study of Socialization Project has received funding from the National Institute of Mental Health (1978-1979), the Milton Foundation (1978-1979), and the Spencer Foundation (in three grants, 1978-1979, 1979-1980, 1980-1981). It involves ethnographic and sociolinguistic research among the Kwara'ae of Malaita Island, in the Solomon Islands. Principal Investigator is Watson-Gegeo, and David W. Gegeo is researcher.
3. The Homemaker Research Project, which involved qualitative research on homemaker/home health aide training classrooms and indepth interviewing, was funded by the Massachusetts Board of Regional Community Colleges and the Massachusetts Department of Public Welfare (March 1979-June 1980). Watson-Gegeo served as methodological consultant.
4. Research on Hawaiian talk story carried out by Watson-Gegeo in classrooms and Hawaiian peer groups, was supported by the National Institute of Mental Health (1970-1971).

5. New federal guidelines liberalizing conditions under which informed consent must be obtained will go into effect in July 1981.

6. For example, in the BCIP project, formal permission to conduct the research was obtained from the Chicago Department of Education, the principal of the school, the parent-community organization, the teachers, and the children's parents.

7. Gleason obtained formal permission from the assistant superintendent, the director of the building, and the supervisor of the ward, prior to beginning his research. In keeping with federal guidelines, he informally explained his research to primary caretaker staff and others on the ward of the large state school for the mentally retarded, where his research took place.

8. Maldonado-Guzman is consultant for the Ethnographic Study of Migrant Children in Boston and San Juan Puerto Rico project, funded by the Ford Foundation. The principal investigators are German Diaz Pérez and Lucia David. This project is one of two carried out under the umbrella project Harvard-University of Massachusetts Ethnographic Study, funded by the Ford Foundation; principal investigators for the Harvard portion are Maldonado-Guzman, Robert Carrasco, and Courtney Cazden.

9. Arthur Vera.

10. Stated in a workshop at the University of New Mexico, July 1980, Albuquerque, New Mexico.

11. Gleason found that nearly the entire administrative staff had changed when he returned to the institution the second year, after a break of a few months. It meant that he had to negotiate

re-entry at all the levels involved in the original negotiation. Watson-Gegeo had a similar experience in Hawaii, in which personnel had not changed, but the social organization of the setting had been entirely altered. She and Gegeo also find that each time they return to continue their research in the Solomons, they must begin all over again, and negotiate entry at all levels of government as well as with the villagers with whom they work.

12. Emic (adjective) refers to interpretations of rules and meanings, including concepts and categories, from the sociocultural insider's point of view and "native" knowledge or understandings. It is contrasted with etic, which refers to concepts and categories applicable to comparative analysis, used by the researcher who is a cultural outsider (or who takes that stance for analytic purposes).

13. The Sociolinguistic Survey of Southeast Asia project was a joint effort of the East-West Center and the Regional English Language Centre, Singapore (1972-1976). Watson-Gegeo served as co-coordinator, with P. W. J. Nababan of Indonesia, from 1973-1975. The project was terminated prior to collecting any data, when political events in Laos, Cambodia, and Vietnam forced their withdrawal.

14. Videotape viewing sessions with the teacher may be held while the data are being collected or after all data have been gathered, depending on the objectives of the project. The first strategy is used when the goal is to affect teaching practice, or in interactive/ participatory research. The second strategy is used when researchers are concerned with capturing naturally-occurring behavior unaffected by mutual analysis after each event or session.

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Learning from Diagrams: Theoretical and Instructional Considerations

by

William D. Winn William G. Holliday

Department of Curriculum and Instruction
University of Calgary
Calgary
Canada

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Diagrams of all types are frequently used in texts and other forms of instructional material. Unfortunately, the way in which these diagrams are designed often leaves as much to inspired guess-work as it does to sound principles of instruction and instructional design. While it is true that on many occasions diagrams prepared in this way can do a good job of instructing students in many areas, all too often this is not the case. This is because there has been little empirical research on the effectiveness of various types of diagram, in which the unique features of diagrams have been controlled experimentally. As a result of this, there are few specific principles for the design, preparation and use of diagrams that have a basis in scientific research. The purpose of the studies reported in this paper was two-fold: to identify some of the relationships that exist between the unique properties of diagrams and various aspects of cognitive processes and learning; and, subsequently, to derive principles from these relationships which would direct the design and use of diagrams in the classroom.

The unique properties of diagrams can be discussed in four different contexts. The first of these consists of the special ways in which diagrams convey information. Diagrams differ from text and from realistic pictures in a number of important ways. While, like text, they are capable of presenting information in written verbal form, the written language they contain is usually highly abbreviated; and arranged on the page in ways that express the logical relationships among ideas by means of spatial layout rather than through syntax. Through exploiting the spatial dimension, diagrams therefore resemble pictures. But they do so only to a limited degree. To begin with, the conceptual domains that they represent are frequently quite abstract, such as "The Nitrogen Cycle", with the result that any isomorphism they exhibit with a domain of referents is logically rather than iconically derived. Also, taken as a whole, the purpose of diagrams is usually to teach conceptual relationships rather than to teach identification. This gives a priority to conceptual structure rather to realism. Diagrams therefore exhibit properties of both text and pictures, and as such are "logical pictures" of the type described by Knowlton (1966). The ability of diagrams to teach conceptual organization has been confirmed by Gropper (1970). The advantages of expressing logical relationships spatially has been investigated by many researchers. It has been found, for example, that the use of "spatial paralogic" in the solution of syllogisms, where the syllogisms are presented as diagrams in which logical relationships are displayed spatially, improves the ability of the learner to solve the syllogisms, (De Soto, London and Handel, 1965; Johnson-Laird and Steedman, (1978).

The second context within which to study diagrams involves the way that they relate to the text in which they occur. In most instructional (but not necessarily experimental) situations, diagrams are embedded in some form of textual presentation. In many instances, there is a certain amount of redundancy between the diagram and the text, and this, like any form of redundancy, tends to improve retention. However, matters are not always as straightforward as this. Anderson (1970) and Samuels (1970) have both suggested that the presentation of two instructional media, such as a diagram and text, does not necessarily guarantee better learning. Learners tend to exert the least amount of effort needed to learn. They will therefore tend to pay attention to the most familiar medium, text, and less attention to the diagram, on the assumption that they can get all the information they need from the text. Such an expectation in learners is constantly reinforced by what Olson has called "the literate bias of schooling" (1977), and empirical support for the phenomenon was found in one of the studies discussed in more detail below (Holliday, 1976).

The third context within which to examine the properties of diagrams involves their ability to direct attention. There are in fact three aspects to this. The first has already been touched upon. Since diagrams present only the abbreviated equivalent of text, often only labels consisting of single words, they are highly simplified representations of conceptual domains. As a result of this, the designer of diagrams has a great degree of control over what particular concepts are highlighted in the diagram. Through this control, attention of learners can be directed pretty much at will. Second, diagrams can incorporate pictures of varying degrees of realism. For example, a diagram illustrating insect metamorphosis might include pictures of the insects. Just like any other pictures, these can include cues, such as color highlighting, arrows, and so on, that draw attention to the critical features of the insects and help students learn to identify and classify them. Such visual cueing is by no means new, and has been discussed at length by several researchers (Dwyer, 1972, 1978; Fleming and Levie, 1978; Merrill and Tennyson, 1977). However, it has not been exploited as much as it might have been in diagrams. In combination with the other unique properties of diagrams, it becomes a most powerful instructional tool. Finally, the attention-focussing property of diagrams can be enhanced by the use of adjunct study questions. Again, research in the use of study questions to direct learners' attention to important information has been relatively plentiful (Markle and Capie, 1976; Rickards, 1979; Wilson and Koran, 1976). However, this useful mathemagenic device has not been used with diagrams, again overlooking a potentially very powerful combination of strategies for use in instruction.

The final context within which to approach the unique properties of diagrams is learner ability. Since diagrams, as we have seen, exploit verbal, spatial and sometimes iconic forms of communication in order to instruct, it would seem logical that learners' verbal and spatial aptitude would predict success in learning from them. While the relationship between verbal ability and learning from text is well established, the same cannot be said for spatial ability and learning from material presented in spatial formats (see Cronbach and Snow, 1977, chapter 9). Part of the problem has to do with the weak construct validity of tests of spatial aptitude. However, the hypothesis that low-verbal high-spatial learners would learn better from diagrams than from text is an attractive one, and one that was tested in several of the studies discussed below. As will be seen, the findings were by no means clear cut.

The eight studies examined hypotheses developed within each of these four contexts. They therefore provided information about how learning in general, and cognitive processes in particular, are related to: the way in which diagrams present conceptual domains spatially; the interactions between diagrams and the texts within which they are embedded; the ways in which diagrams draw attention to important information; and the ways in which learners' verbal and spatial ability predict their success in learning from diagrams.

The Studies

Winn (1980a) "Food chains"

One hundred and twenty-two grade nine students were randomly assigned to a text and a text plus diagram treatment teaching "food chains". The diagram was derived from digraph analysis (Norman, Harary and Cartwright, 1965) of the content. As a result, fifteen concepts naming either features of food chains or animals in a typical food chain were placed in a block-word diagram that captured structurally the logical properties of the relationships among them. Subjects made free word associations to the fifteen concepts both as a pre- and posttest, and took comprehension pre- and posttests as well. Using techniques for the comparison of the structures of matrices of coefficients of association among the concepts, derived from Shavelson (1972, 1974), it was found that instruction improved the organizational structure of the conceptual domain that the students learned. Also, high-ability students (verbal reasoning + numerical ability from the Differential Aptitude Test battery, [Bennett, Seashore and Wesman, 1972]) performed better after studying the text plus diagram treatment than after studying text alone. There was no difference for low-ability students. These results were interpreted in terms of the ability of diagrams to provide built-in structural organization for conceptual domains, and in terms of the ability of high-ability learners to handle redundant information better than low-ability learners.

Winn (1981a) "Insects"

Two hundred and twenty-one grade nine students were randomly assigned to three instructional slide sets teaching insect metamorphosis. In one slide set, the critical features of four types of insect at different stages of metamorphosis were highlighted by arrows, and attention was drawn to them by a narrator. In the second slide set, features were not highlighted; rather the insects were presented as line drawings in a chart which showed stages of metamorphosis vertically, and insect types, grouped by whether they went through simple or complete metamorphosis, horizontally across the page. The third slide set simply showed pictures of the insects. Subjects took posttests requiring them to match pictures of insects with words naming the various types of insect, the stages, and the two types of metamorphosis. Significant aptitude-treatment interactions were found, with the V2 test from the Kit of Reference Tests for Cognitive Factors (French, Ekstrom and Price, 1963) as predictor, indicating that the treatment highlighting critical features benefitted high-verbal subjects more than the slide set using the charts, with no difference for low-verbals, when the dependent variable was the number of correct identifications. On the other hand, high-verbals scored better on tests of classification by type of metamorphosis when they saw the chart slide set than when they saw the slides highlighting critical features. Again, there was no difference for low-verbals. These results were interpreted as indicating the relative advantages, for identification and classification of concepts, of attribute highlighting and spatial diagrammatic arrangement, and, coincidentally, that tests of verbal ability predict much more than just skill with language.

Winn (1981b) "Dinosaurs"

Two hundred and seventy-three grade nine subjects were randomly assigned to one of four treatments teaching the evolution of dinosaurs. In the first treatment, a horizontally oriented tree diagram ran left to right across the page, in which names of categories of dinosaurs ("carnivorous", "duck-billed") and names of species of dinosaur ("triceratops", "brontosaurus") were located relative to a geological time scale, with the oldest dinosaurs on the left of the page. A second treatment used the same diagram, but also included line drawings of each animal above its name. The remaining two treatments were the same as the first two, but reversed left to right and top to bottom, with the oldest dinosaurs on the right, and the time scale on the bottom. A control group read a text that gave no information about the evolution or appearance of the dinosaurs, but which did include all the dinosaur species and type names that appeared in the diagram. After studying the diagram they were given, subjects took four posttests designed to assess their knowledge of the evolutionary sequence, the geological period during which each dinosaur lived, and two classification tests requiring the assignment of each animal to its immediately superordinate category (e.g. "duckbilled"), or to a broader superordinate category (e.g. "lizard hipped"). Significant main effects indicated that subjects seeing either of the reversed diagrams scored lower than those seeing the left-to-right ordered diagrams, and that those who saw line drawings were better able to identify dinosaurs by type. Further, subjects seeing normal ordered diagrams were better able to classify the animals by type of hip than subjects who saw the reversed diagrams. An aptitude-treatment interaction, using the V2 test from the French kit (French et. el., 1963) as the predictor, indicated that high-verbal subjects performed better on classifying the dinosaurs by type than high-verbal subjects in the reversed order group, but that there was no difference for low-verbals. Spatial ability, measured by the card rotation test from the same kit, predicted little. These results were interpreted as suggesting that the tendency of learners to "read" diagrams from left to right is powerful in predicting how they process the information presented in diagrams. Also, pictures included in diagrams help teach identification. Again, it was suggested that tests of verbal ability predict a general processing skill.

Holliday (1976) "Diagrams and Text"

Two hundred seven high school students were randomly assigned to five instructional groups: 1. picture-word diagram (PWD), 2. block-word diagram (BWD), 3. text, 4. picture-word diagram plus text (PWD+T) and 5. block-word diagram plus text (BWD+T). These two flow diagrams described cyclic schema (i.e., biogeochemical cycles) by condensing the verbal discourse found in the text into a single coherent display using arrowed lines, verbal labels and colored line drawings (PWD) or black-and-white geometric symbols (BWD). In addition, students were administered an achievement test after instruction evaluating students' understanding of the commonly expressed information. In the present study, the PWD and BWD groups outperformed the PWD+T and the BWD+T groups respectively and outperformed the text group. These main effect findings were interpreted in terms of Gropper (1970) and Spangenberg's (1971) model of instructional effectiveness related to the presentation of verbal chain information displayed in a single coherent diagram. Results from the first (diagram vs. text) hypothesis were consistent with Gropper's (1970) "diagram versus conventional instructional" experiment and Spangenberg's (1971) "coherent diagrams versus text" experiment. These two studies dealt with separate instructional diagram types and clearly represent the most relevant research associated with the present study. Unfortunately, Gropper was unable to control the "conventional instruction" treatment alternative relative to the diagram treatment, thereby reducing the internal validity of his experiment. However, his general remarks about diagram design and his description of the experimental verbal diagrams represented a major contribution to our theoretical knowledge about general diagram design. Spangenberg in his study was able to describe his experimental variables in a clear, precise fashion. However, the kinds of displayed information and the evaluated learning behaviors investigated by Spangenberg were not directly relevant to the classroom. Results from the second hypothesis (diagram vs. diagram and text) were consistent with work done in selective attention or cue selections. Subjects who were presented either flow diagram achieved higher scores than those presented with a combination of a diagram and text. Importantly, the instructive questions used as adjunct aids in all treatments were placed directly below the flow diagrams (i.e., never below the texts) whenever possible (PWD, BWD, PWD+T, BWD+T) in an attempt to persuade learners to answer questions using the diagrams and not just the text. Fleming (1962) noted over a decade ago that teachers, parents, and students assigned an overinflated value to text material. School teachers ordinarily spend little time training children to interpret pictures, and no time is usually devoted to instructional diagrams. Perhaps, the flow diagrams investigated in combination with a text probably suffered from two disadvantages: 1) students had not been trained how to use them; and 2) students believed that more could be learned from the text than most other instructional forms, since more school time generally had been devoted to it.

Holliday, Brunner and Donais (1977) "Picture vs. Block Word Diagrams"

Eighty-three high school students were randomly assigned to two instructional groups: 1. picture-word diagram (PWD), or 2. block-word diagram (BWD). These two flow diagrams described cyclic schema (i.e., biogeochemical cycles) by condensing the verbal discourse found in the text into a single coherent display using arrowed lines, verbal labels and colored line drawings (PWD) or black-and-white geometric symbols (BWD). In addition, students were administered a verbal ability (V2) aptitude test from the Kit of Reference Tests for Cognitive Abilities (French, et al., 1963) before instruction and after instruction an achievement test was administered evaluating students' understanding of the commonly presented information. Lower verbal students retain more information when provided with a PWD rather than a BWD. In contrast, higher verbal students did not differentially respond to the posttest instrument. These instruction findings were interpreted in terms of the Linguistic-Imaginal Model (Holliday, 1975), a synthesis of Paivio's (1971) coding and memory hypothesis concerning images and verbal information, and Cronbach and Snow's (1977) aptitude-treatment interaction (ATI) hypothesis concerning individual learner differences. This Model was created to interpret verbal and nonverbal information in terms of individual learner differences. Accordingly, it does predict that instructional material will generally be processed in an independent and interdependent mental fashion using linguistic and imaginal coding and memory units. These mental units should be considered as intervening variables, for whether they actually exist as such in the mind (or in the brain) is currently a matter of conjecture. The Model also predicts that learners' linguistic or imaginal abilities differentially determine their responses to learning materials. In the present study, results suggest that learners with lower verbal performance will have more difficulty learning from certain "verbally dependent" materials such as block-word diagram. In contrast, learners with higher verbal performance will have less difficulty learning from verbally dependent materials. An obvious research goal is to clarify the nature of the verbal construct as it relates to diagrammatic materials. Nevertheless, classroom materials similar to those used in this study perhaps should be well illustrated, especially for those students designated as low verbal even though such materials are more expensive to produce and even though the present ATI issues have not been resolved to completion.

Holliday (1978) "Population vs. sample question"

One hundred seventy-five high school students were randomly assigned to four groups: 1. picture-word diagram plus 20 study questions (population-questions), 2. picture-word diagram plus five randomly selected questions (sample-questions), 3. picture-word diagram (no question), and 4. placebo text. This flow diagram described cyclic schema (i.e., biogeochemical cycles) by condensing the verbal discourse often found in textbooks into a single coherent display using arrowed lines, verbal labels and colored line drawings. Subsequent to instruction, students were administered a comprehension posttest based on an operationally-defined synthesis and paraphrase of two or more study questions. The results supported the a priori hypotheses. First, the population-question group and the no-question group independently outperformed the sample-question group which, in turn, outperformed the placebo-control group. In this latter respect, future research dealing with study questions should evaluate treatment data in terms of control data because such information helps establish evidence that experimental questions are adjunct facilitators or inhibitors of learning, according to Faw et al. (1976), McConkie (1977) and Rickards (1979). Unfortunately, many interesting studies lacking such control might have been helpful in clarifying instructional issues dealing with questions. Indeed, the questioning studies the attentional model suggest that selectively directing learners' attention to a sampling of the instructional material can result in dysfunctional focusing and incomplete cueing, thus reducing student comprehension of criterial information. In contrast, not focusing learners' attention on selected portions of the same information apparently encourages students (no-question group in this case) to develop and implement their own learning strategies without study aids or provides other students (population-question group) with a "complete" instructional support system. A no-question (reading-only) group in the present study was considered a treatment (not a typical control) and was included to evaluate the hypothetical advantage of an uncued flow diagram. McConkie (1977) predicted that well-control question studies in the future would result in the reading only groups outperforming some reading-with-adjunct question groups, as suggested by more recent literature (after 1970). Consequently, a placebo-control group was used to establish a base level of performance in assessing the learning effects of the least functional, sample-question treatment. Indeed, the control group data supported the claim that the students comprehended information presented in the diagram even when they were provided with a potentially dysfunctional study aid (i.e., a portion of study questions) adjunct to the flow diagram.

Holliday (1980) "Overprompting" study

One hundred seventy-one high school students were randomly assigned to four groups: 1. picture-word diagrams plus 20 study questions (PWD+20Q), 2. picture-word diagram plus 20 study questions under a strongly prompted condition (PWD+20Q+strongly prompted), 3. picture-word diagram (PWD), 4. a placebo text (PT). This flow diagram described cyclic schema (i.e., biogeochemical cycles) by condensing the verbal discourse often found in textbooks into a single coherent display using arrowed lines, verbal labels and colored line drawings. Subsequent to instruction, students were administered a comprehension posttest based on an operationally defined synthesis and paraphrase of two or more study questions. The results supported the a priori hypothesis that the PWD+20Q group independently outperformed the PWD+20Q+strongly prompted group which, in turn, outperformed the PT control group. The no-question group failed to outperform the prompted group, as predicted. The findings in this study were interpreted in terms of an model (see Anderson, 1970, Anderson and Biddle, 1975, McConkie, 1977, Rickard, 1979, and Wittrock and Lumsdaine, 1977) suggesting that strong prompts to study questions can reduce the attention students pay to the critical information resulting in inadequate processing of information. First, the model suggested that students who received the unprompted-question treatment were forced to read each question carefully and search the diagram for the correct answer to each question, thus increasing the likelihood of meaningful attention and comprehension. Second, this model suggested that students in the present study who received the strongly prompted question treatment repeatedly encountered printed numbers in the diagram adjacent to verbal labels. As students responded to the adjunct questions, many learners perhaps discovered that these numbers were next to the labels constituting the answers to the questions assigned to the same number. Consequently, these students likely shortcutted the read-and-search-for-the-answer method of responding when they discovered that the adjunct questions could be answered more easily by merely locating in the diagram the printed numbers corresponding to question numbers and by responding to each question on this basis. Logically, this counter-productive shortcut method of answering questions would have been easier for students than carefully reading each question and searching for the appropriate verbal label answers printed in the diagram.

Holliday and Benson (1981) "Chart orientations and postquestions"

Two hundred ninety-nine high school students were randomly assigned to four classroom orientations (1. no intervention, 2. comment by teacher indicating that the study questions were instructionally important, 3. students had one minute to inspect the posttest, 4. combined interventions - two and three), and four postquestion-focusing devices within each orientation and a placebo-control text. The four question treatments consisted of: 1. a vitamin chart describing their sources and their effects on people (no-question), 2. the same chart with postquestions covering source information columns (source postquestion), 4. the same chart with postquestions covering effect information columns (effect postquestion), and 5. the same chart with questions covering total source-and-effect information columns (source-effect postquestion). Specifically, the instructional chart (format derived from charts found in high school biology textbooks) consisted of a 14-row (14 vitamins) four-column (two source and two effect attributes) matrix. The questions used during instruction were "mathemagenic" postquestions presented after each row of vitamin information presentation. This procedure occurred 14 times. Specifically, students examined a vitamin row consisting of four columns and then answered a postquestion asking for information pertaining to one of the four vitamin attributes. Review of the previous vitamin row was prohibited because the present study was examining cognitive process hypotheses concerning attention and not instructional efficiency hypotheses. Subsequently, students were administered a retention posttest covering the last seven vitamin rows of the chart, in an attempt to induce set and as recommended by McConkie (1977). Students were provided with a seven-by-four fill-in-the-blank chart and asked to complete the 28-attribute cells using the four lists (seven attributes in each list) printed on the same paper below the chart. Generally, the results supported the a prior hypotheses that postquestions can positively influence students' attention in favor of questioned material and that inspection of the chart-like posttest (i.e., McConkie's performance expectancy) can result in greater recall of information presented in the instructional chart under the no-question treatment. Furthermore, students provided with source-effect postquestions did not recall more information than the non question groups. This latter finding was consistent with those of Holliday (1980) and McConkie's (1977) suggestion that students' attention can be selectively focused on portions of instructional information; however, such nondirectional postquestions often fail to facilitate the simple recall of memorized information. In contrast, the use of directional postquestions (source or effect postquestions) proved to have a potent effect on learners. For example, students provided with effect postquestions recognized more effect (than source) attributes on the posttest even though the source attributes were more easily recognized by the no-question and the source-effect postquestion treatments under the four orientations. Perhaps such strong attention effects suggests the power of postquestions, especially when the domain of attention is perhaps clearer to learners (say, using a chart medium) rather than a medium that prevents a similar degree of compartmentalization of conceptual (e.g., vitamin A) attributes (e.g., food source - carrots). In theory, McConkie (1977) argued that learners' retention of presented information in mathemagenic postquestion studies is dependent on the task structure, the task strategies adopted by the learner and the person's own schemata. Previous research suggested that the task structure in these studies was often vague in learners' minds. As a consequence, different strategies were adopted by learners resulting in difficult-to-interpret patterns of posttest data. The four orientations used in this study help clarify some problems of learner vagueness. Second, learners often were evaluated on their retention of information presented too early in the instructional treatment, thus masking out potential effects on the posttests and preventing the establishment of attention sets. In the present study, learner recognition was evaluated (after the presentation of seven vitamins) after some degree of attention set was likely induced by postquestion treatments, thus maximizing the chances of detecting differential postquestion effects. The present study accounted for McConkie's concerns by evaluating not only the effects of varied postquestion treatments but also different learners' orientations. Indeed, providing learners with clear expectations about the posttest affected performance in this study. In addition, set was allowed some time to form in the learners' mind by not evaluating students' performance on the first seven vitamins presented in the experiment.

The conclusions from these studies can be summarized as follows.

1. Diagrams help learners learn because they direct attention to important information, replacing critical verbal information with graphic devices such as lines and arrows. They show which concepts "go with" which others, aiding generalization and discrimination, by placing concept labels in the same or different rectangles.

2. Diagrams help low-verbal learners overcome some of their difficulty with language by providing information in a form they can handle more easily.

3. Through the use of normal left-right, top-bottom layout, arrows and other graphic devices, diagrams can teach sequences of events effectively, as well as make it easier to learn classification schemes. The relative effectiveness on sequencing and patterning is to an extent dependent on learners' verbal (general) ability.

4. The addition of study questions to diagrams helps learners by directing their attention to critical information, but must be used with care because they also direct attention away from information that is not questioned.

5. Likewise, prompting can be useful in helping learners. However, overprompting can be dysfunctional as it encourages learners to learn surface information rather than the more important underlying concepts shown in the diagram.

Discussion

Theoretical Considerations

One of the two major purposes of these studies was to explore, and at the same time develop, a theoretical framework within which to research and design diagrams. The theoretical implications of the studies will be examined and then related to a comprehensive model of cognition proposed by Bransford (1979). It will be necessary, therefore, to examine the impact of the various properties of diagrams as instructional materials on learning and cognition, the learning activities studied, the relationships between diagrams and learner ability, and the criterial tasks studied in the experiments.

Perhaps the most unique feature of diagrams has turned out to be their ability to present concepts spatially. As was mentioned earlier, diagrams map interconcept relationships onto a two-dimensional space, thereby providing a visual representation of the structure of conceptual domains. The use of a spatial metaphor to represent semantic "distance" or "space" in this way has been found to be profitable in a variety of other studies (Shavelson, 1972; Thro, 1978; DeSoto, London and Handel, 1965; Johnson-Laird and Steedman, 1978). In the "food chain" study, the use of a diagram to represent in visual form the semantic distances between pairs of concepts in the domain to be learned, improved the ability of all learners to organize meaningfully the set of fifteen concepts. Posttest association scores were significantly superior to pretest scores. Also, the spatial arrangement of concepts appears to help students learn the classification of concepts. In both the "insects" and the "dinosaurs" studies, a diagrammatic treatment improved learners' classification scores significantly.

These results suggest that there may be a similarity between the way a diagram lays out concepts on a page, and the way in which that information is represented and processed internally. There has been considerable debate recently concerning imaginal as opposed to propositional representation of information (Anderson, 1978; Kosslyn, 1980; Kosslyn and Pomerantz, 1977; Fleming, 1977). It has been suggested (Winn, 1980b) that whether visual information is represented as images or propositions is determined in part by the nature of the information and the nature of the demands placed upon the learner to process and use that information in particular ways. For example, an identification task will cause information to be encoded and processed as an image, while more complex tasks, such as problem solving and classification, may well require propositional encoding. As far as diagrams are concerned, it appears that their spatial quality causes a certain amount of imaginal encoding, at least to the extent that the spatial orientation of one concept to another is encoded in a way that corresponds to their actual relationship on the page. It is also possible that this is achieved through the structural properties of the diagrams activating abstract schemata to which the concepts appearing in the diagrams can be more readily assimilated. For example, learners interpret a chart, such as that used in the "insect" study, as a ready-made classification scheme of a type with which they are already quite familiar. This schema is then "instantiated" (Anderson, 1977, 1978) with the particular concepts the diagram contains. Evidence for this notion is to be found in the "dinosaur" study, where reversing the diagrams left to right caused a decrement not just in the ability to learn sequences, but also in the ability to classify the dinosuars into superordinate categories. When studying normal order diagrams, learners reading from left to right would have encountered superordinate concept labels before they saw the names of the dinosaurs which belonged in each category. In other words, a relatively abstract classification system was set up before the concepts belonging in each category were encountered. With reversed diagrams, the opposite occurred, which caused confusion and less learning. Many researchers have claimed that learning depends upon the interaction of top-down and bottom-up processes, whereby existing schemata are as influential as percepts (Bobrow and Norman, 1975; Anderson, 1978; Norman and Bobrow, 1976). When such schemata do not exist, learning is impeded.

Schema theory also offers an explanation of the effectiveness of another feature of some of the diagrams used in these studies. In those instances that the inclusion of realistic pictures within diagrams helped learners identify concepts, as in the "insect" and "dinosaur" studies, as well as in the picture-word versus block-word diagram study by Holliday et. al. (1977), it seems likely that the realistic presentation of critical features of concepts allowed them to be more readily assimilated to schemata, whether the schemata existed prior to the study, or were established as a result of the abstract nature of the diagrams themselves in the way just described. Many accounts have been given of why feature matching is necessary for the assimilation of information to schemata to occur (see Mandler, 1980; Schneider and Shiffrin, 1977). It is generally assumed that learned information is stored in schemata that are composed of concepts strongly enough associated that the presence of just one of them in short-term memory is all that is required for the entire schema to be activated through the matching of that feature to the same feature stored as part of a schema in long term memory. In other words, if a learner has learned what a mayfly larva looks like well enough for a mayfly larva schema to be solidly established in memory, then the perception of something with three "tails" will be sufficient for that schema to be activated. The rest of the identification process is then a top-down verification of the hypothesis that it is indeed a mayfly larva. The graphic and auditory highlighting of critical features such as these makes the activation process that much easier, as it increases the likelihood of the correct schema being activated.

The spatial nature of diagrams also means that there is correspondence between internal and external representation of sequences of concepts. While this was only studied explicitly in the "dinosaur" study, in all the others, sequence was an important part of the content to be learned. Decay follows death in the nitrogen cycle. Larvae change into pupae, and not vice versa. Snakes eat mice, but mice do not eat snakes. Diagrams can show sequences such as these either by assuming that learners will process them left to right, or by emphasizing direction by means of arrows and other graphic devices. The latter were used in the Holliday studies of the nitrogen cycle, the former in the "dinosaur" study. The use of both techniques improved learner performance.

As far as the relationships between learner aptitude and diagrammatic treatments are concerned, the studies suggest two different types of effect. These effects correspond to what Salomon (1979) has identified as "supplantation" in instructional materials of those mental skills that learners do not possess, and the "activation" by the materials of those skills that they do possess. In the Holliday et. al. (1977) study of the nitrogen cycle, it was found that picture-word diagrams led to better performance than block-word diagrams for low-verbal learners, suggesting that the presence of pictures made up for their verbal deficiencies. On the other hand, in Winn's three studies, high-verbal learners did better with various types of diagram depending on the performance expected of them. These findings are not necessarily contradictory. In the Holliday et. al. study, the picture-word diagrams were more appropriate for the low-verbal learners according to the supplantation hypothesis. Winn's results, however, suggested that verbal ability was a measure of general processing ability, a finding also reported by Hunt (1978), Hunt, Frost and Lunneborg (1973), and Hunt, Lunneborg and Lewis (1975). It therefore seems that high-ability students are more likely to possess mental skills that can be activated by diagrams, such as using spatial cues to organize concepts, and, in the "insect" study, using attribute highlighting to classify concepts, a visual skill. So while diagrams appear to be able to supplant skills that are deficient, they can also activate appropriate skills in learners who possess them. The failure of tests of spatial ability to predict success in learning from diagrams is probably due to the fact that the tests did not tap those skills that learners actually needed to employ to succeed. The question of the construct validity of aptitude tests was alluded to above, and is discussed in more detail in Cronbach and Snow (1977, chapter 9), by Carroll (1976), and by Hunt (1978).

The attention model (Anderson, 1970; McConkie, 1977; Samuels, 1970; Wittrock and Lumsdaine, 1977) used to explain the selective focusing effects of adjunct questions and presentational devices has been clarified by these eight studies and extended to selected classroom learning materials. These studies supported the general model, that is, learners' attention can be manipulated using questions and cueing devices.

First, postquestions used with a chart can focus learners' attention more on questioned and less on non questioned information. Second, fewer study questions covering only a portion of the criterial information can misdirect learners' attention when using a flow diagram, resulting in lower levels of comprehension. Third, overprompting answers to study questions covering diagrammed information also can reduce comprehension. Thus, questions in a sense can have a facilitory and inhibitory learning effect. Questions can positively direct students' attention to information or can negatively divert students' attention away from non questioned information or merely reduce students' attention by strongly or mildly suggesting, hinting or overprompting the physical locations of desired answers in instructional media. This latter effect is of particular importance because instructional decision makers often view questions as automatic adjunct learning aids. Similarly, the "Diagram and text" study supported the attention model. Here, students' attention was directed away from the more effective information display (i.e., flow diagrams) using the more familiar medium (i.e., the text) as a distraction device. Finally, the "Food chains", "Insects" and "Dinosaurs" studies supported the attention hypothesis and, respectively, showed how a block-word diagram can focus students' attention on key conceptual relationships, how color highlighting and arrows can direct attention to important cues and how ordering of sequential events in diagrams can affect students' attention and subsequent processing of the displayed information. These studies help clarify and extend some specific aspects of Anderson's (1970) analysis of selective attention model which states that students tend to follow the path of least effort and use the easiest possible method to learn information. Indeed, even "motivated students" process only selective information and often fail to pay attention and comprehend the criterial information. Anderson recommended that instructional designers arrange school materials so students are forced to attend to all of the important information rather than permitting the use of dysfunctional shortcuts to learning.

Wittrock and Lumsdaine (1977) argue the usefulness of the attention model in predicting the effects of other techniques (e.g., providing students with instructional objectives) used to influence students' activities during learning situations. More generally, the selective attentional model can account for the fact that learners differentially focus on instructional events and transform or translate some nominal stimuli (e.g., teacher talk, prose passage) into functional stimuli without practice or reinforcement of observable behaviors. Such cognitive psychological analysis using this and other models can facilitate our understanding of how study questions can help or hinder students' learning and recall of information presented in texts and in specialized learning materials. Indeed, Rickards (1979) concluded from his analysis of recent question research that such process models were particularly valuable in exploring and clarifying theoretical issues regarding learner processing of classroom materials not ordinarily mentioned in mathemagenic studies.

The attention model also has led to the re-analysis of overprompting as a common device used by authors of school learning materials. Two forms of overprompting are often found in the classroom. First, a common strong prompting technique consists of underlining or bold printing desired responses to verbatim (i.e., word-for-word), transformed verbatim (i.e., rearranging substantive passage words) or comprehensive style questions. Second, a milder prompting technique found in the classroom often consists of issuing either verbatim or transformed verbatim questions without underlining or bold printing target answers. Anderson (1970) and Anderson and Biddle (1975) theorized that such overprompting techniques reduced student searching or inspection behavior of prose materials, resulting in little meaningful attention to queried information. Previous studies (Anderson and Faust, 1967; Anderson, Faust and Roderick, 1968; Faust and Anderson, 1967) exploring strong prompting mechanisms described in inhibitory overprompting hypotheses were evaluated under poorly controlled conditions using memorization criterial tasks of questionable application to school subject matter.

Milder versions of overprompting also occur in today's classrooms and include the use of verbatim and transformed verbatim study questions so often found at the end of textbook chapters. Future attentional research work in education should concentrate on the effectiveness of these question types. Anderson (1972) argues that answering such overprompted questions (even without employing strong prompting systems) requires little thought and does not constitute evidence of learner comprehension of textbook information. Yet, these questions are often used in the classroom. Unfortunately, verbatim style questions can be answered with a minimal of attentional coordination between cued and response "surface information" (cf. Chomsky, 1965), resulting in the learning of strings of word shapes and of word sounds, but not necessarily the learning of word meanings (Anderson and

Biddle, 1975). Furthermore, research suggests that students can answer verbatim style questions without decoding and comprehending the presented information. For example, Holliday and Whittaker (1978) reported, in an aptitude-treatment interaction (ATI) study dealing with non-diagrammatic displays, that verbatim questions apparently inhibited the comprehension of an adjunct prose passage describing fossils, especially in low verbal students. In contrast, a prose-without-questions treatment resulted in higher posttest scores. The presumption was that many low verbal students thought that merely copying an answer from the adjunct text to the response blanks provided on the verbatim question sheet constituted an adequate method of preparing for the posttest when, in fact, a no-question text-only treatment constituted a more powerful learning medium in terms of visual comprehension of the verbally described fossils. This recent classroom research, the present question studies and earlier work lend support to the selective attention model as a reliable source of supportable hypotheses and to Anderson's (1970; 1972) contention that a chief instructional goal is to arrange and organize learning materials so as to force students to do all of the attentional processsing necessary for the comprehension of information. Anderson (1972) and Anderson and Biddle (1975) suggested that future studies dealing with questions include a clear explanation regarding the relationships between instructional (e.g., diagram and study questions) and evaluative (e.g., test items) materials and a documented rationale arguing the scientific usefulness of manipulating and measuring such variables. Apparently, many question studies vaguely describe seemingly uninteresting variables and provide no rational for their use, as verified in Anderson's (1972) detailed analysis of journal articles. In the "Population vs. sample questions" and the "Overprompting" studies, a paraphrasing technique adapted from Anderson and Biddle's (1975) work was used to maximize the likelihood of measuring learner comprehension. Specifically, "verbs" and important modifiers were "equivalent" yet different among the diagram, study questions and test items, thus increasing the chance of measuring (in both interrogative forms) longer-term storage of informaiton and semantic encoding of conceptual relationships, as argued by Bormuth (1970). Otherwise, Anderson (1970, 1972) suggests that students provided with verbatim questions are likely to take the path of least effort and merely encode "surface" or verbatim information such as strings of word sounds, shapes and their relative physical distance and direction among each other. Apparently, such a learning behavior can occur when students are provided with prose passages and verbatim questions containing either identical or reordered word patterns, as shown by Anderson (1972).

An organizational framework has been proposed by Bransford (1979) to clarify recent research and theory in human cognition as it relates to classroom situations. Bransford's framework is generally consistent with many theorists (e.g., Ausubel, 1963; Bartlett, 1932; Bloom, 1976; Jenkins, 1978) and highlights relationships among the characteristics of the learner, critical tasks, learning activities and the nature of the materials. In this respect, the applied findings of the present eight studies and their theoretical considerations need to be placed in such an often used framework (Brown, 1981) so as to clarify the relationships among these studies and other works more broadly concerned with learning, understanding and remembering and to provide a model for exploring future research related to these present studies. On the one hand, inspection of Bransford's framework suggests that the findings reported in these studies clarify our understanding about how instructional designers can alter the learning activities of students with specific schemata by using diagrammatic materials and special cueing devices and evaluating performance effects by using different kinds of criteria. On the other hand, Bransford reminds us that research studies and their resulting data patterns are limited in terms of his framework. First, the "Characteristics of Learners" component of the framework includes those variables measured by the verbal and spatial aptitude tests and an infinite number of other variables. The authors of the eight studies made no claim that even the most "important" variables were measured, for Cronbach and Snow (1977) suggested that our understanding of differential aptitude variables in this sense has barely commenced. The only claim made by the present authors is that the aptitude measures used in the ATI studies described here constituted reasonable measures in light of the current literature and instrument availability. Future research work will surely facilitate the development of more comprehensive and valid instruments, including more precise measures of learners' schemata of relevant knowledge and skills. In this respect, it is crucial to assess students' schemata in relation to the other three components of Bransford's model. Second, the "Criterial Tasks" (component of the framework) used to measure learning included information retained and comprehended of the specific kind described. Once again, there are many valid criterial tasks not measured in these studies yet of great importance to instructional designers. Readers of the present studies must keep in mind these limitations. For example, overprompting may be of less consequence when students are asked to recognize or recall information, as is often the case in the classroom. The present studies measured a form of comprehension - a task requiring different processes, according to Anderson and Biddle (1975). Third, some "Learning Activities" used by students in these studies probably were manipulated and indirectly measured (e.g., attention) but others (e.g., rehearsal, elaboration) were neither evaluated nor varied in any systematic fashion. Yet, these activities surely accounted for more learning variance. Consequently, instructional designers must consider other studies focusing on such activities as retention, forgetting, interference, imagining and levels of processing, while interpreting the present research findings. Fourth, the "Nature of the presented Materials" (framework component) varied among the studies and were unique in each study. Varying the complexity, modality, and sequencing of the concept might well have altered the reported study findings. The point is that the theoretical considerations and the practical applications described in this paper must be kept in perspective - a deceptively simple but in fact a complex task. Finally, evaluating the influences of diagrams on learning demands that researchers and readers of research keep the present study findings in perspective.

Practical Considerations

Beyond the theoretical considerations arising from these studies, several practical "design principles" can be derived for application when designing and using diagrams. These can be stated as follows.

1. When designing diagrams to show sequences, designers should give priority to ordering the concepts to be learned left to right and top to bottom on the page. Although arrows are useful for showing sequence, they are not sufficiently powerful devices to override the normal "reading" conventions. In the "dinosaur" study, arrowed lines did not make it any easier for subjects to learn from reversed diagrams.

2. The actual distance between concepts in the diagram should have some correspondence to the semantic distance in the conceptual domain that is represented in the diagram. In most of the studies, the displayed spatial relationships among concepts in the diagram were isomorphic to association strengths between each concept pair, and learning was improved.

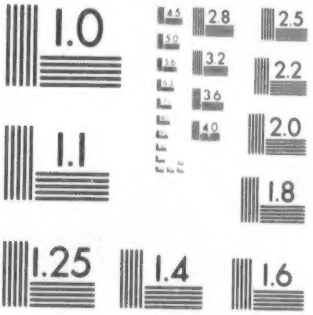
3. When the objective is to teach classification, superordinate concept labels should be placed so that they are encountered before labels naming instances of each concept. This can be

achieved by placing them to the left and above subordinate concept labels, or by making them more perceptually prominent, such as writing them in bold face or upper case letters.

4. When the objective is to teach, among other things, the identification of concepts within the domain represented by the diagram, pictures should be incorporated into the diagram in such a way that the critical features of the concept are highlighted. This can be achieved by any number of cueing strategies.

5. On the other hand, diagrams should not be too detailed. Used with text, they are inevitably partly redundant, and making them too information-laden will reduce the chances that low-ability learners will use them and learn from them. At the very least, learners who are known to be less able should always be given more time to study diagrams along with text, for they require more time to integrate the information from the two sources, to assimilate that information to existing schemata, and to accommodate those schemata to it through top-down processing.

6. Diagrams should be used whenever possible if entirely new information is to be presented. In such cases, well-formed schemata do not exist to which the information can be assimilated. However, learners who are familiar with the meaning of such graphic conventions as columns, rows, arrows, lines, captions, and so on, will be able to use these to set up an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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS
STANDARD REFERENCE MATERIAL 1010a
(ANSI and ISO TEST CHART No. 2)

abstract organizational schema to which the new information will be quite easily assimilated. This also implies that some learners may need training in "diagram literacy".

7. Provided enough time is given for study, picture diagrams can be extremely helpful to low-verbal (low ability) learners. This is because, through their inherent organization and by way of the inclusion of pictures, they supplant those verbal skills in which the learners are weak.

8. Diagrams with a reasonable amount of redundancy, can be used without hesitation if the learners are known to be of reasonably high ability. These students will have little difficulty using those unique features of diagrams that are appropriate to the content in order to process the information they contain as efficiently as possible.

It is hoped that future studies will confirm these principles and also develop others that will lead to better design and more effective use of diagrams in instruction.

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